

BARBRO ENESKÄR

CHILDREN'S LANGUAGE
AT FOUR AND SIX

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CHILDREN'S LANGUAGE AT FOUR AND SIX

A longitudinal and multi-variable study of
language abilities among children

AV
BARBRO ENESKÄR

FIL. KAND.

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CHILDREN'S LANGUAGE AT FOUR AND SIX.

A longitudinal and multi-variable study of language abilities among children.

Referat (sammandrag)

The book describes language abilities in about 250 coeval Swedish children at the ages of 4 and 6 and the reading and writing performance of those children at the end of the first year of school. Part 1 discusses the theoretical background of the investigation and gives an account of its aims and arrangement. Part 2 deals with the children's articulation, part 3 with their vocabulary and part 4 with their sentence structure. Part 5 deals with interrelations between articulation, vocabulary and sentence structure and the relation of these language abilities to reading and writing abilities at the age of 8. A hypothetical model of language structure is finally suggested; this model is based partly on empirical results from the present investigation.

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INTRODUCTION

The aim of the project here presented is to supplement Swedish child language research by studying several aspects in a fairly large number of children of the same age over a period of some years, ie to make a longitudinal investigation of the language of children.

During the project, data were collected on articulation, vocabulary and sentence structure in about 250 Swedish children at the ages of 4, 6, 8 and 10, and on the reading and writing performance of those children from the end of the first year of school and the start of the fourth. In addition, some background data were obtained from the children's parents. These data concern the children's physical, mental and emotional development, socio-economic circumstances, verbal stimulation and intellectual performance.

The main aims of the project can be summed up in the following three points.

1. Description of language abilities in children at different ages, and thus of their language development.
2. Studies of interrelations between various language abilities and of the question of which language abilities at any given age have strong relations to the language at another age, including reading and writing abilities at school. On the basis of the results it may be possible to make suggestions for measures to promote language development.
3. Studies of interrelations between language abilities and background variables.

In five reports in the series Pedagogisk-psykologiska problem /Educational and Psychological Problems/ (Malmö: School of Education) I have given an account of the children's language at the ages of 4 and 6 and shown relations between the language at these ages and reading and writing performance at the age of 8.

Part I, corresponding to Report No. 329 and Chapter 1 here, discusses the theoretical background of the investigation and gives an account of its aims and arrangement.

Part II, corresponding to Report No. 331 and Chapter 2 here, deals

with the children's articulation.

Part III, corresponding to Report No. 332 and Chapter 3 here, deals with the children's vocabulary.

Part IV, corresponding to Report No. 336 and Chapter 4 here, deals with the children's sentence structure.

Part V, corresponding to Report No. 339 and Chapter 5 here, deals with the correlation between articulation, vocabulary and sentence structure and the relation of these language abilities to reading and writing abilities at the age of 8.

Data on relations between language abilities and background variables are not yet calculated and therefore not included in any of these reports.

1 THEORY, AIMS AND METHODS

1.1 Language, language ability and language structure

Language is specific for man and we must assume that it is due to certain structures in the human brain. We do not talk with our tongues and lips but with our brains. The ability to command language is always a central one.

"In order to master the phonetic or expressional system of a language it is necessary to be able to separate the component elements (phonemes, prosodemes, morphemes, etc) and to use these according to the rules that apply to their joining into larger units (syllables, groups, sentences). In other words, one must master the paradigmatic system (the stock of elements and their relationships to each other, the oppositions) and the syntagmatic system (the contrasts). On the grammatical level it is a question of the correct functional use of the forms of the words (morphology) and the joining of these together into sentences according to the rules for syntax (word order, congruence, reference, superordination, subordination, etc). And it is finally a question of mastering a reasonable vocabulary - according, of course, to the needs, general intelligence and educational level of the speaker (no-one masters the entire vocabulary of a language) - and of knowing the semantic content of the words ('understanding' them). Every communication, moreover, always necessarily includes stylistic means of expression at various levels - a selection of sounds, forms, sentence structure and words, lending the utterance a value over and above its purely intellectual content." (Malmberg, 1971, pp 169-170, our translation)

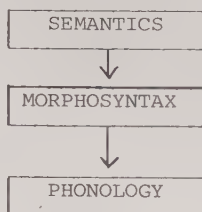
There may be language handicaps of both production and perception. These are either inborn or acquired, and in serious cases give rise to phenomena that have been designated word blindness, expressive aphasia, agrammatism, reading and writing difficulties and so on. According to Malmberg, all these different expressions of linguistic disability are manifestations of the same phenomenon. Speech and writing difficulties reflect the same deficient capacity for abstraction and class formation as the phoneme defects and are therefore in a deeper sense the same phenomenon (Malmberg, 1971, pp 170-171).

"A lack of awareness of this basic fact has probably largely contributed to producing a negative influence on the result of teaching in speech and writing difficulties in Swedish schools." (Malmberg, 1971, p 172, our translation)

Sigurd shows a model describing how different language components are interconnected. He calls it a model of expressive grammar,

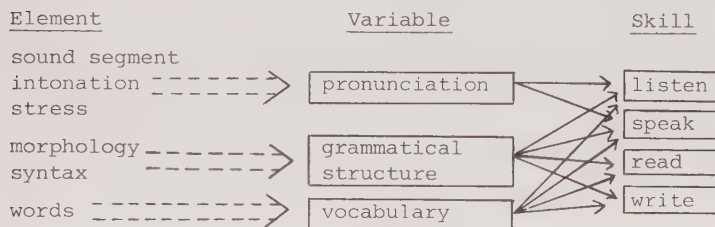
"... since it almost seems to reflect how one expresses oneself or

'clothes one's thoughts in words'. It feels easier to build performance models on this type of grammar. It is the morphosyntactical component which shows the various possibilities we have of clothing our thoughts in words. The semantic component shows the thoughts."



(Sigurd, 1972, pp 40-41, our translation)

Lado (1961) considers that language consists of elements constituting variables, which in their turn are integrated into the total abilities of speaking, hearing, reading, writing and possibly translating. Löfgren (1969) has summarized Lado's theories in the following way:

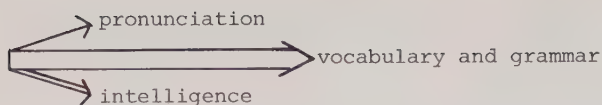


(Löfgren, p 5)

The central field in this model, as can be seen, bears great similarity to Sigurd's model of expressive grammar. Löfgren (1969, 1972a, 1972b) in his studies has contributed to the understanding of how the language proficiency is built up and has also tried to find out which measurements should be included in a battery of tests that is to measure the total language proficiency from as many sides as possible.

Samples of pupil groups in grade 6, 7 and 9 were given a test battery which had been designed from a theory of the relationship between language variables and integrated abilities. The data collected were processed by methods of factor analysis, and factor structures were obtained for each pupil group.

The analyses showed that language proficiency could be seen as a rather closely-knit unit with high correlations between different language tests. It was possible, however, to sort out certain aspects of language proficiency. The figure below, shows a summary picture of the results from the three factor analyses.



The figure shows how language proficiency has been divided up into three factors. Proficiency in vocabulary and grammar has proved to be a very central factor. Thus simple vocabulary and grammar tests can give a very accurate measurement of language proficiency. The intelligence factor consisted of two reference tests measuring verbal ability and mainly reading comprehension tests and some of the listening comprehension tests. The pronunciation factor consisted only of different pronunciation tests. It has thus been shown that the traditional division into hearing, speaking, reading and writing does not reflect the factorial composition of language proficiency.

The language dimensions given above are based, then, on results obtained from tests of language ability in foreign language. It is interesting to find that other researchers who have studied individual differences in both spoken and written language have also mainly worked with variables having to do with vocabulary and structural knowledge or, as linguisticians express it, variables concerning lexicon and syntax. Teleman works with a lexical and a syntactic analysis of written utterances. It

"... was assumed that the difference between good and poor writers could partly be described grammatically: the former used lexicon and syntax in a different way from the latter." (Teleman, 1974, p 9, our translation)

It was supposed that individual differences in the use of language due to different education, stylistic level, writing training, capacity, etc, could be organized along five dimensions: 1. Complexity (Concentration), 2. Topology (Disposition), 3. Specification, 4. Modality, 5. Textual cohesion.

On the basis of the theories and empirical findings given above it seems to me suitable to work, in the present investigation, on the hypothesis that language ability can be usefully divided up into the dimensions of articulation, vocabulary and sentence structure. Since, however, these concepts are not entirely unequivocal I prefer for the time being to use operational definitions for these concepts. By this I mean that articulation, vocabulary and sentence structure are defined by means of the test variables.

1.2 Aims and issues of the investigation

A child's whole development, socially, intellectually and emotionally, is intimately related to its language development. It is therefore important at as early a stage as possible to be able to identify children showing a retarded or deviant language development, so that they can be given suitable help of a pedagogical or other nature with the aim of improving their linguistic performance before there is time for secondary problems to develop in the form of psychological adjustment problems or school difficulties.

In order to determine whether a child's language development is retarded or otherwise deviant, one must be able to compare it with other children of the same age, which in its turn demands extensive knowledge of the performance of children at a certain age in different language abilities such as articulation, vocabulary and sentence structure. One should in addition know how these language abilities develop, which deviations are relatively unimportant and which ones are of greater importance for the continued development of the child in any one respect, such as reading and writing performance at school.

Generally, the research on Swedish child language that has thus far been carried out has either concentrated on intensive studies of a small number of children (Bolin, 1916, 1920; Andersson & Emenius, 1970; Rydin, 1971; Lange, 1974, 1975, 1976; Lange & Larsson, 1972, 1973, 1977; Söderberg, 1971, 1973; Holmlund, 1974; and Lindhagen, 1976) or confined itself to studies of only one part of language behaviour, such as phonematic development (Westerlund, 1963; Stenborg & Bengtsson, 1970, 1973; Ericsson & Hammarberg, 1971) or vocabulary (Erasmie, 1970).

It is hard to make generalizations from the work of the first researchers mentioned above, and from the work of the latter ones generalizations can only be made about certain areas within children's language. It has therefore been felt necessary to make the attempt to give a more comprehensive picture of a larger number of coeval children's language performances at different ages.

The main aim of the present investigation is to collect data on various language abilities in a group of children who are followed from 4 to 10 years of age, so as to gain increased knowledge of how children's language abilities look at a certain age and of how they develop from one age to another. It is hoped that this knowledge can then be of help in identifying children with retarded or deviant language development. Since the same children have been followed through several different ages it will be poss-

ible to study the question of whether the children grow out of retardations and deviations so to speak by themselves.

The second aim of the investigation is to make studies of correlations between different language abilities, also considering future reading and writing performances at school. If it becomes clear that a certain type of language behaviour, for instance poor vocabulary at the age of 4, has a high correlation with reading performances at age 8, it is possible that there is a causal relationship here. If this is so, improvement of vocabulary at age 4 may perhaps lead to improved reading and writing performances at school and thus forestall or at least reduce a number of pedagogical problems.

The third aim of the investigation is to study the correlation of different background variables with language abilities. For this purpose data have been collected from the health checkups of the children's welfare centres at age 4, which include information on the children's physical and mental health and the health and socio-economic situation of the parents. We also interviewed the parents at the checkups at age 4 and age 6, where we gained information on such matters as their occupations, education and living conditions. We also asked about the children's interest in books, radio and TV, etc, to try to gain some measure of the verbal stimulation in the home. At age 6 we also gave all the children Raven's Coloured Matrices, a non-verbal intelligence test. At age 8 and 10 the children took an attitude test to show their attitude to various school subjects, school-mates and teachers.

Studies concerning this third aim are not included in this book.

1.3 Measurement times

When the present investigation was planned about eight years ago, child language research had not developed as rapidly as it has during the last few years. It was therefore Templin's investigation of 1957 that came to represent the chief model when we were working out the design for this investigation, and I followed some of her advice to future researchers in the subject, including that of the desirability of longitudinal studies. The advantage of this is that one can find out whether children develop at different rates and whether this may perhaps be due to some background factor or factors. By following the development of the same children for several years it is also possible to ascertain whether certain language deficiencies disappear spontaneously and to attempt to sort these out from other more serious disturbances or defects which need some sort of treat-

ment, medical or pedagogical.

How early, then, should the attempt be made to identify children with deficient language development?

We considered that age 4 was suitable for the first data collection of the investigation for the following reasons:

1. The health checkup at age 4, now more and more usual in Sweden, gave a practical opportunity of studying a large number of coeval children.
2. It is a suitable and relatively simple procedure to supplement this health checkup in future with a language examination.
3. It is not until the age of 4 that children are sufficiently cooperative or have sufficient powers of concentration to manage a test requiring about 30 minutes.
4. At age 4 children's language is quite well developed in most of the linguistic areas, and they should have stabilised their language enough to make it possible to study their language development.
5. At the time of the checkup at age 4, the children's welfare centres collect a quantity of background data by means of interviews and questionnaires, some of which data can be used in the present investigation.

The second collection of data took place when the children were aged 6. This age was considered suitable and important for two chief reasons:

1. The language should have developed far enough, especially in the question of articulation, to make it possible to ascertain which deficiencies have been compensated without remedial measures being taken. This in its turn would be important for planning treatment.
2. The children are about to start school. When they are faced with learning to read and write it would be important to find out which children still have language problems.

The next point in time for collecting data was set at the age of 8. One argument for this may be that the same time interval is retained. What is more important, however, is that reading and writing abilities have by then developed enough to enable studies with some degree of personal profile to be made.

The age of 10 was considered suitable for the fourth examination. Among the arguments in favour of this age the following can be mentioned:

1. It is relatively unusual to follow children for as long as 6 years, which makes it especially interesting to collect data a further time.
2. While the children have just learnt to read and write at the age of 8, their abilities have developed far enough at the age of 10 for various

partial abilities to be studied in more detail.

3. In another project concerned with children's language development, the FRIS Project (FRIS Group, 1976), the written language of the 10-year-olds had been studied. The FRIS data and my own might give possibilities of interesting comparisons.

1.4 Measuring instruments

When one wishes to study the language abilities of children, which comprise their ability both to produce language and to understand it, one can either study spontaneous speech, from entirely unstructured observations in a natural environment to observations in formal laboratory situations, or else use more or less standardised tests. Both methods have advantages and disadvantages. The main disadvantage of the spontaneous method is that it is time-consuming, especially if there is no guidance whatsoever in the form of pictures or toys which can help to elicit speech. The fact that the spontaneous method has no time limit, however, is also an advantage, since children's language may vary a great deal in different situations as to both utterance quantity and sentence structure, as has been confirmed by Holmlund (1974) among others.

The advantage of specially-designed tests is primarily that one can try to elicit certain words and constructions for which one otherwise may have to wait a long time.

When one is studying the understanding of language, the children do not as a rule need to make any utterances but only to nod, point or perform some action. Testing of this type is particularly important for children whose production is disturbed, for example by articulation or sentence-building difficulties. It is quite difficult, however, to design tests of this type for small children.

In studies of individual variations within one age group and in studies of development from one age to another it is particularly important to be sure that the differences in performance are not due to disparity in stimulus. The most suitable procedure is therefore to make the test situation as standardised as possible by making the tests highly structured.

Box 1 gives a schematic representation of the tests used at the four measurement times.

I designed the Articulation, Instruction and Question Tests together with Gunvor Digerfeldt (Digerfeldt & Eneskär, 1970). All the tests will be described in more detail in later sections.

Box 1. Tests at different measurement times

Test	Measurement times			
	Age 4	Age 6	Age 8	Age 10
<u>Articulation:</u>				
Articulation Test	x	x	x	
<u>Vocabulary:</u>				
Articulation Test	x	x	x	
Question Test, oral	x	x	x	x
Instruction Test	x			
Ljungblad's Vocabulary from the Autumn Test (1967)		x	x ¹	
WISC Vocabulary Test (1970)		x	x	
Free Narration Test			x	x
<u>Sentence structure:</u>				
Question Test, oral	x	x	x	x
Question Test, written				x
WISC Vocabulary Test		x	x	
Free Narration Test			x	x
<u>Reading and writing:</u>				
Malmquist's Test 4 for silent reading, first year (1970)			x	
Lindahl's H4 Test, reading aloud			x ¹	
DLS (diagnostic reading and writing) Dictation Test, first year (1970)			x ¹	
DLS Reading Comprehension Test, third year (1976)				x
<u>Miscellaneous:</u>				
Ljungblad's Autumn Test			x ¹	
Raven's Coloured Matrices (1963)		x		
Attitude Questionnaire for Adjustment			x	x

¹ Only for children attending Malmö schools

1.5 Population and sample

In the present investigation the population from which the survey group is taken comprises all children who are

- a. 4 years of age,
- b. Swedish citizens speaking Swedish at home, and
- c. registered for census purposes in the municipality of Malmö.

According to the files of the health control service the number of children fitting these criteria born in April 1967 was 285. By the start of testing, however, 16 of them had moved away from Malmö and one further child had been placed in the School for the Blind in Norrköping due to a serious defect of vision. There then remained 268 children. Of these, 254 appeared for our tests. After the end of the examination two boys were excluded from the sample because their mothers spoke Danish and Faeroese,

which was clearly apparent in the children's articulation.

The age 4 examination thus covered 252 children, 131 (52%) boys and 121 (48%) girls. By the second measurement time 12 children had moved so far away from Malmö that it would have been far too costly to visit them. None of the parents of the previously tested children refused to appear, so that the age 6 examination covered 240 children, 126 (52%) boys and 114 (48%) girls. By the third measurement time 9 more children had moved far from the Malmö region, so that the age 8 examination covered 231 children, 120 (52%) boys and 111 (48%) girls. At the fourth measurement time, the age 10 examination, 229 children were tested, 120 (52%) boys and 118 (48%) girls.

At the age 4 examination the age varied from 4 years 3 months to 4 years 7 months (mean value 4 years 167 days, ie very nearly 4 1/2 years) and at the age 6 examination it varied from 5 years 11 months to 6 years 2 months. Generalization should therefore only be applied to children within these age ranges.

The sampling can also be seen from a chronological point of view. One can perhaps reasonably suppose that results from 4-year-olds in 1967 could be generalized to apply to 4-year-olds in 1968 and some subsequent years, even if of course circumstances gradually change so as to render this generalization more difficult.

It may perhaps be claimed that the group of children studied should best be considered as a population of its own. Among the consequences of this would be the avoidance of statistical significance tests. I have performed these calculations, however, to assist those readers who consider that the sample represents the population in a more or less acceptable fashion.

2 STUDIES OF ARTICULATION

2.1 Description of the Articulation Test

The Articulation Test was designed for studies of the childrens' articulation. The test consists of pictures and objects representing 57 different test words, which were assumed to be known to a 4-year-old. In the test words the children were tested on the consonants l, g, r and s (Malmberg, 1970, p 122) and on 52 consonant combinations (concerning the marking by underlining, see p.21). These consisted of 25 initial double combinations and 3 initial triple combinations, 27 final double combinations and 1 final triple combination. The individual consonants were given both initially and finally, g only initially since it does not occur finally in Swedish. The test thus comprised 63 items, ie consonants or consonant combinations tested, these being included in 57 different words.

By means of sentence completions, toys and slide pictures the children were induced to say the test words spontaneously, their articulation then being noted. If the children did not answer with the test word expected, the articulation was tested by imitation of the tester. Wrongly spontaneously articulated items were also tested two further times by imitation.

Certain spontaneous errors could then be corrected, new errors sometimes arising at the same time. Apart from the above raw score variables a number of percentual variables were designed.

The Articulation Test is presented below in Box 2.

Box 2. Articulation Test

Test word Swedish/English	Test item	Test word Swedish/English	Test item
1. STOL/chair	1. st-	31. HÄST/horse	33. -st
2. BORD/table	2. -rd	32. SAX/scissors	34. s-
3. BRUNT/brown	3. br-		35. -ks
4. SPIS/stove	4. sp-	33. SNÖ/snow	36. sn-
5. DISKBÄNK/sink	5. -nk	34. FLYGPLAN/aeroplane	37. fl-
6. GARAGE/garage	6. -j	35. TVÄL/soap	38. tv-
7. TRAPPA/stairs	7. tr-	36. KRAN/tap	39. kr-
8. KORG/basket	8. -rj	37. FILT/blanket	40. -lt
9. KÖKET/kitchen	9. g-	38. SLIPS/tie	41. -ps
10. RING/ring	10. r-	39. SPRINGER/runs	42. spr-
11. PLÅSTER/plaster	11. pl-	40. FORT/quick	43. -rt
12. SMÖRGÅS/sandwich	12. sm-	41. HALS/neck	44. -ls
13. KLOCKA/clock	13. kl-	42. DRICKER/drinks	45. dr-
14. SVAMP/mushroom	14. -mp	43. SAFT/juice	46. -ft
15. SKED/spoon	15. j-	44. MJÖLK/milk	47. mj-
16. KNIV/knife	16. kn-		48. -lk
17. GLAS/glass	17. gl-	45. BÖRS/purse	49. -rs
	18. -s	46. GOLV/floor	50. -lv
18. SVANS/tail	19. sv-	47. SKOR/shoes	51. sk-
	20. -ns		52. -r
19. GRIS/pig	21. gr-	48. STRUMPOR/stockings	53. str-
20. TOFS/tassel	22. -fs	49. KVÄLLEN/evening	54. kv-
21. BURK/tin	23. -rk	50. BLOMMA/flower	55. bl-
22. VISP/whisk	24. -sp	51. FJÄRIL/butterfly	56. fj-
23. SKRATTA/laugh	25. skr-	52. KORV/sausage	57. -rv
24. PRATA/talk	26. pr-	53. ELEFANT/elephant	58. -nt
25. BLIXT/lightning	27. -kst	54. BJÖRN/bear	59. bj-
26. FRYSER/freezes	28. fr-		60. -rn
27. MOLN/cloud	29. -ln	55. SKÄRP/belt	61. -rp
28. ORM/snake	30. -rm	56. FISK/fish	62. -sk
29. HAND/hand	31. -nd	57. SLÅSS/fight	63. sl-
30. VAGN/carriage	32. -gn		

Box 3 below shows how the measurement variables were designed.

Box 3. Design of measurement variables in the Articulation Test

	1. spontaneous correct items	2. spontaneous errors (incorrect items)		3. unanswered	
	(spontaneous correct items)	4. corrected spontaneous errors	5. non-corrected spontaneous errors	7. new errors	6. new correct items
Spontaneous					
Imitation					
	8. total correct items	9. remaining errors			

↑ -----

Furthermore, the different types of articulation errors were classified as follows:

O_1 = omission of the first consonant in a consonant combination, eg [ku:] instead of [sku:].

- O₂ = omission of the second consonant in a consonant combination, eg [bærn] instead of [bjærn].
- S₁ = substitution of the first consonant in a consonant combination, eg [grIkər] instead of [drIkər].
- S₂ = substitution of the second consonant in a consonant combination, eg [mɔlm] instead of [mɔln].
- S₁S₂ = both consonants are substituted by two other consonants, eg [vɪft] instead of [vɪsp].
- SO = substitution + omission. The two consonants are replaced by one other consonant, eg [fans] instead of [svans].
- T = error in one of the triple combinations skr-, spr-, str- and -kst.
- C = error in the individual consonants s, r, ɟ or ʃ, eg [fe:d] instead of [ʃe:d].
- I = inversion, eg [govl] instead of [golv].
- M = miscellaneous errors, ie errors that cannot be placed in one of the above categories. This includes errors of addition, eg [tɔpfs] instead of [tɔfs] or grave simplifications such as [vø:] instead of [mjælk].

Only one error or one type of error can occur per item. Both spontaneous and remaining errors were classified according to these 10 categories.

An error is counted every time there is not correct articulation of both the consonants of a consonant combination (one or both consonants have been omitted or substituted), or when the consonants are not articulated in the right order, or when the individual consonants r, s, ʃ and ɟ have been omitted or substituted.

The variants or allophones of the consonants have of course been judged as correct articulation. Both Scanian (southern) and northern or central Swedish r and ʃ have been accepted. The designations r and ʃ also cover all the allophones of /r/ and /ʃ/, such as [r], [R], [ʃ] and [ʂ] (Malmberg, 1970, p 122). I have also considered the lisping s (apico-dental lisping) as an allophone of s and not as a different phoneme, which means that this form of lisping has been judged as correct articulation.

When judging errors, no difference has been made between phonematic and phonetic errors, since an analysis of this type requires more detailed studies, where not only the production of phonemes but also their perception should be tested. This is why I do not use phonematic designations for the consonants and consonant combinations tested. These are indicated instead throughout by underlining, and dashes have been placed before or after them to show which of them are initial and which final in the test words.

2.2 Results for the Articulation Test

The results for all children tested at age 4 and 6 are shown in Box 4. Since

the majority of variables show skewed distribution, the age differences were significance-tested by Wilcoxon's test for matched pairs (Siegel, 1956). Analysis of variance was also performed with repeated measurement for each individual variable (BMD08V, Dixon 1973), chiefly to make it possible to calculate ω^2 , which shows the strength of the correlations between age and articulation variables.

According to Box 4 there is a highly significant age difference for 43 of the 60 articulation variables ($p \leq 0.001$). A further 4 variables show significance between 0.001 and 0.05. The values of ω^2 at 0.05 and above have been marked by underlining. A ω^2 value of at least 0.05 is considered to indicate an important difference.

The majority of age differences suggest that the children have shown a marked improvement in articulation from age 4 to age 6. According to the mean values 46.82 and 58.53, the children spontaneously managed almost 12 items more at age 6 than at age 4. According to the medians 50.12 and 59.69 the difference was closer to 10 items. At age 4, however, a larger percentage of spontaneous errors was corrected, so that the difference in the total number of correct items is not so great. These mean values were 56.81 and 61.19 and the median values 60.50 and 62.27, ie a difference of 4 and 2 items respectively. The percentual variables of spontaneous correct items and total correct items show significant articulation improvements from age 4 to age 6.

As a natural consequence, the number and percentage of unanswered items, spontaneous errors and remaining errors have also reduced from age 4 to age 6.

It is interesting that not only the number of errors has reduced but also the distributions of the type of error have changed with age. At age 4 the errors of omission are the most common, both absolutely and percentually, but at age 6 the substitution errors are most common. Errors in the individual consonants l, g, s and r (C-errors), together with SO-errors where both the consonants have been substituted by a completely different consonant are both absolutely and percentually considerably more common at age 4 than at age 6. This is true of spontaneous and remaining errors alike. Inversion errors and errors in triple combinations are also commonest at age 4, absolutely, but percentually both these error types are more common among the spontaneous errors of the 6-year-olds than among the 4-year-olds. Among the remaining errors, though, there is no age difference for inversion errors and errors in triple combination.

These results confirm the theories according to which the type of ar-

Box 4. Results for the Articulation Test

Variables	n	Mean values		Investigation of age differences		
				Analysis of variance	Wilcoxon's test	
		Age 4	Age 6	p	χ^2	p
Raw score variables:						
1. Spontaneous correct items	240	46.82	58.53	xxx	0.33	xxx
2. Spontaneous errors	"	7.45	2.55	xxx	0.11	xxx
3. Unanswered	"	8.50	1.93	xxx	0.38	xxx
4. Corrected spontaneous errors	185	3.22	1.28	xxx	0.19	xxx
5. Non-corrected spontaneous errors	"	5.22	1.98	xxx	0.05	xxx
6. New correct items	231	7.07	1.76	xxx	0.41	xxx
7. New errors	"	1.63	0.25	xxx	0.07	xxx
8. Total correct items	"	56.81	61.19	xxx	0.08	xxx
9. Remaining errors	"	5.90	1.80	xxx	0.07	xxx
10. Spontaneous O ₁ -errors	"	1.71	0.20	xxx	0.14	xxx
11. " O ₂ -errors	"	1.61	0.28	xxx	0.10	xxx
12. " S ₁ -errors	"	0.71	0.55	n.s	0.01	n.s
13. " S ₂ -errors	"	1.28	0.71	xxx	0.05	xxx
14. " S ₁ S ₂ -errors	"	0.08	0.08	n.s	0.01	n.s
15. " SO-errors	"	0.40	0.10	xxx	0.03	xxx
16. " T-errors	"	0.49	0.15	xxx	0.05	xxx
17. " C-errors	"	0.78	0.26	xxx	0.06	xxx
18. " I-errors	"	0.27	0.13	xxx	0.02	xxx
19. " M-errors	"	0.15	0.07	n.s	0.01	n.s
20. Remaining O ₁ -errors	"	1.25	0.15	xxx	0.07	xxx
21. " O ₂ -errors	"	1.30	0.19	xxx	0.05	xxx
22. " S ₁ -errors	"	0.41	0.34	n.s	0.00	n.s
23. " S ₂ -errors	"	0.83	0.53	xxx	0.02	xxx
24. " S ₁ S ₂ -errors	"	0.10	0.08	n.s	0.00	n.s
25. " SO-errors	"	0.37	0.08	xxx	0.02	xxx
26. " T-errors	"	0.58	0.18	xxx	0.05	xxx
27. " C-errors	"	0.63	0.09	xxx	0.08	xxx
28. " I-errors	"	0.32	0.11	xxx	0.03	xxx
29. " M-errors	"	0.11	0.05	n.s	0.00	n.s
Percent variables:						
Of spontaneously answered items:						
30. % spontaneous correct items	240	85.74	95.77	xxx	0.13	xxx
31. " spontaneous errors	"	14.25	4.23	xxx	0.13	xxx
Of spontaneously unanswered items:						
32. % new correct items	189	86.17	89.98	x	0.01	xxx
33. " new errors	188	13.84	9.84	x	0.01	xxx
Of spontaneous errors:						
34. % corrected errors	182	57.29	51.38	n.s	0.01	x
35. " non-corrected errors	"	43.29	47.75	n.s	0.00	n.s
Of total number of items:						
36. % spontaneous correct items	240	74.68	92.84	xxx	0.32	xxx
37. " spontaneous errors	"	11.90	4.15	xxx	0.11	xxx
38. " unanswered	"	13.59	3.18	xxx	0.38	xxx
39. " total correct items	"	90.56	97.05	xxx	0.07	xxx
40. " remaining errors	"	9.44	2.95	xxx	0.07	xxx
Of spontaneous errors:						
41. % O ₁ -errors	182	19.89	6.64	xxx	0.09	xxx

Box 4. (cont.)

Variables	n	Mean values		Investigation of age differences		
				Analysis of variance		Wilcoxon's test
		Age 4	Age 6	p	ω^2	p
Percent variables:						
42. % O ₂ -errors	182	20.29	10.78	xxx	0.04	xxx
43. " S ₁ -errors	"	9.96	22.87	xxx	<u>0.06</u>	xxx
44. " S ₂ -errors	"	26.15	32.84	x	0.01	xx
45. " S ₁ S ₂ -errors	"	1.23	2.60	n.s	0.01	n.s
46. " SO-errors	"	3.58	1.60	xx	0.02	xxx
47. " T-errors	"	4.74	9.20	x	0.02	n.s
48. " C-errors	"	9.95	3.70	xxx	<u>0.05</u>	xxx
49. " I-errors	"	3.05	6.36	x	0.01	x
50. " M-errors	"	1.50	3.37	n.s	0.01	n.s
Of remaining errors:						
51. % O ₁ -errors	125	15.78	7.70	xx	0.03	xxx
52. " O ₂ -errors	"	16.17	8.38	xxx	<u>0.04</u>	xxx
53. " S ₁ -errors	"	6.08	16.41	xxx	<u>0.05</u>	xxx
54. " S ₂ -errors	"	22.66	37.13	xxx	<u>0.04</u>	xxx
55. " S ₁ S ₂ -errors	"	3.92	4.04	n.s	0.00	n.s
56. " SO-errors	"	4.12	1.06	xxx	0.04	xxx
57. " T-errors	"	9.25	9.64	n.s	0.00	n.s
58. " C-errors	"	12.09	3.46	xxx	<u>0.05</u>	xxx
59. " I-errors	"	7.66	7.98	n.s	<u>0.00</u>	n.s
60. " M-errors	"	2.28	4.13	n.s	0.00	n.s

x = $p \leq 0.05$, xx = $p \leq 0.01$, xxx = $p \leq 0.001$, n.s = not significant

ticulation error follows different stages of children's language development. The children first omit those phonemes which they have not mastered. The phoneme is then substituted by another that has already been learned. This substitution phoneme then grows increasingly like the phoneme intended until the child finally masters that as well.

The investigation of sex differences showed only a few significant F ratios. However ω^2 was in no case 0.05 or higher. Thus the sex of the children does not appear to have any great effect on their performances in this articulation test.

2.3 Results for individual items in the Articulation Test. Correlation of articulation with vocabulary and language frequencies

When the various items were ranked according to the number of articulation errors found, the ranking of spontaneous errors was very like the ranking of remaining errors, at age 4. (At age 6 the items had too small a scatter for the frequency of total correct items for a reliable ranking to be carried out.) Comparisons between the number of errors in the items at age 4 and 6 also showed considerable similarities. Certain consonant combinations are

always more difficult than others whether they are articulated spontaneously or by imitation and at whichever age they are articulated (that is, until all the items are articulated correctly by all the children).

The two consonant combinations -ln and fj- produced errors in about 40% of the 4-year-olds. The items leading to 15% or more errors at age 4 were: -rp, -rn, g-, -fs, -sp, -f, tv-, kv-, -rv and -kst. The items leading to 10% or more errors at age 6 were: -nd, -kst, -sp, -rv, -fs and -ln.

Many of the above difficult items contain consonants that are learned quite late, for example the fricatives f and g and the liquids r and l. Such late-learned phonemes, however, also occur in a number of items which the majority of children managed correctly, eg kl-, -st, -ft and -ls, so that the theory of the development of the phoneme system can not by itself explain why certain consonant combinations are more difficult than others. Especially when, as here, it is a question of combinations of consonants, it is natural for one consonant to affect another, ie certain consonants are difficult to combine together purely articulatorily. Certain combinations may also be difficult to perceive when they occur together, especially if one is not very used to hearing or using them. Some hypotheses concerning possible correlations with the degree of difficulty of the items could be tested empirically. The following questions were asked:

1. Are the test words with which the children are less familiar more difficult to articulate than those which are more familiar?
2. Are the test words which are less common in the language more difficult to articulate than those which are more common?
3. Are the items (the consonants and consonant combinations in the test word) which are less common in the language more difficult to articulate than those which are more common?

The first hypothesis was tested by calculating the correlations between the test-word frequency of expected word choice and their frequency of total correct items at age 4. It was assumed that words obtaining a high frequency of expected word choice were better known to the children than those obtaining a low frequency of expected word choice.

The second hypothesis was tested by calculating the correlations between the language frequency of the test words according to Hassler-Göransson's word frequency lists (1966) and the frequency of total correct items at age 4. Both graphic and lexical language frequency were calculated for the test words.

The third hypothesis was tested by calculating the correlations between the language frequency of the items according to Melin's frequency calcula-

tions (1929) and the frequency of total correct items at age 4.

All correlations were calculated by the aid of Spearman's rank correlation (Siegel, 1956). The following correlation matrix was obtained:

Box 5. Correlations between articulation, vocabulary and language frequencies

Variable	Total correct items	Expected word choice	Graphic frequency of test words	Lexical frequency of test words	Language frequency of items
Total correct items	-	.19	.03	.05	.41
Expected word choice	.19	-	.33	.36	.32
Graphic language frequency of test words	.03	.33	-	.81	.34
Lexical language frequency of test words	.05	.36	.81	-	.36
Language frequency of items	.41	.32	.34	.36	-

It is clear from this table that the children gave the expected word choice more often for usual words than for unusual ones. On the other hand the children correctly articulated unusual words as often as usual ones, but they correctly articulated more usual than unusual items. It is after all fairly natural that it is the language frequency for the consonant combination itself and not the language frequency for the whole word which is most important for the articulation of the consonant or the consonant combination.

One reservation must, however, be made in this interpretation since all the language frequencies used above are based on adult language. Words familiar to adults may not be so to a 4-year-old. On the other hand it is probably mainly adult language that children listen to.

2.4 Studies of correlations between Articulation Test items

The above correlations are not particularly high, suggesting that other circumstances are also affecting the degree of difficulty of an item. Possible circumstances include the position of the consonant within the word, the effect of other consonants or vowels on the consonant tested, and of course the phonematic development level of the children. Studies of how the Articulation Test items are intercorrelated may provide further information as to why some items are harder than others, or suggest where the difficulty lies, for example whether it is one special consonant that is causing the difficulty.

Factor analysis was considered suitable for these studies of correlations. On the basis of the number of total correct items and the number of remaining errors for each individual item, two factor analyses based on dichotome corre-

lations (BMDP4M, Dixon, 1973) were calculated for each age. The factor analyses within each age showed very similar results despite some dissimilarities in the number of items and the number of individuals. For this reason, only one factor analysis will be given below for each age: for the 4-year-olds the one based on 62 items and all 252 children, and for the 6-year-olds the one based on 38 items and all 240 children. In the former case, the item kv- was excluded because it had only been given to 186 children, and in the latter case a number of items with too skewed a distribution, those with 0-2 errors, were excluded.

For each item the type of error was also analysed according to the categories described above (O_1 , S_1 , I, etc), which facilitated the interpretation of the factors. Box 6 gives a synopsis of how the factors have been interpreted. The factors are designated by a Roman figure plus the item with the highest loading in the factor.

Box 6. Factors in the Articulation Test

Age 4			Age 6		
Factor		Interpretation	Factor		Interpretation
I	st-	Initial <u>s</u> factor	I	br-	General <u>r</u> factor
II	pr-	Initial <u>r</u> factor	II	-ɲn	Palatal/velar factor
III	-rt	Final <u>r</u> factor	III	sv-	Initial <u>v</u> factor
IV	-s	Final <u>s</u> factor	IV	ɟ-	- Not interpreted
V	bl-	Initial <u>l</u> factor	V	fj-	- Not interpreted
VI	fj-	Factor for consonant combinations with consonants that together are hard to perceive and articulate	VI	-lv	Final <u>v</u> factor
VII	-nt	Dental factor	VII	-fs	Factor for consonant combinations with consonants that together are hard to perceive and articulate
VIII	ɟ-	Fricative factor	VIII-XI		- Not interpreted
IX	-lv	Final <u>v</u> factor			
X	-ɲk	Palatal/velar factor			
XI-XIII		- Not interpreted			

The analyses of factors and types of errors showed that the majority of articulation errors in the items are due to difficulties with a certain consonant, especially r, s, l, ɟ and ɟ, or with a certain consonant group, eg fricatives or liquids. The majority of these consonants are among the phonemes learned late. It therefore appears that, especially at age 4, there are some children who do not yet have a command of the entire phoneme system. Some have difficulties with r, some with ɟ or s, others again perhaps with several consonants. The results show that the items fall into the groups one might expect in view of the children's phonematic development. The position of the consonants within the words may also possibly be of some importance since the items have fallen into groups of initial and final consonant factors.

Difficulties with some of the consonant groups, however, do not seem to be due to problems with one particular consonant. This applies to the ones that have been grouped together under Factor VI, fj-, for age 4 and under Factor VII, -fs, for age 6 and which consist among other things of fj-, -sp, -ln, -fs and -kst. These consonant combinations produced most articulation errors both at age 4 and at age 6. Many of them are fairly uncommon in Swedish, which has already been shown to have some negative effect on the ability to articulate them. Difficulties with these consonant combinations may then be due to the children being unaccustomed to hearing and using them. With certain consonants there is a purely articulatory difficulty in producing them together in these combinations. Problems with the above consonant combinations may thus be due to the fact that the children have not yet learned to listen to them or that they have not yet attained the required articulatory, ie motor-neurological maturity to combine those two consonants. This last suggests that the difficulties are probably more of phonetic than of phonematic origin.

2.5 Comparisons between error types at age 4 and age 6

The analyses of the individual items by error types showed several age differences. As mentioned above, the errors of omission were most common at age 4 and those of substitution at age 6. The individual error types O_1 , O_2 , S_1 and S_2 showed which type of consonant was omitted or substituted and which type of substitution was used for any one consonant. The following conclusions could be drawn:

At each age, only isolated errors in the nasals (m, n and ŋ) occurred, not counting errors in -ln and -ŋn, which were probably not due, however, to the children not having mastered the phoneme /n/.

Errors in occlusives, fricatives and liquids were much more common at age 4 than at age 6. The occlusives were substituted more often than they were omitted, particularly at age 6. For the fricatives at age 4, s was omitted more often than it was substituted, but at age 6 it was the other way round. The consonant j was usually omitted at both age 4 and 6. The fricatives f, v, ʃ and ʒ, on the other hand, were predominantly substituted at both ages. The liquids r and l were usually omitted at both age 4 and 6.

Concerning the types of substitution for each consonant, the similarities between the two ages were more marked than the dissimilarities. The substitutions seemed to follow the development of the phoneme system, phonemes learned late being replaced by those learned earlier. The substitutions greatly resembled the consonants concerned in respect of the manner and place

of articulation. All the consonants had one substitution that was particularly frequent, ʃ for example being most often replaced by [f], ʒ by [s], f by [p], s and k by [t].

The remaining error types - S_1S_2 and the SO errors - where both consonants were replaced by two other consonants or one respectively, the inversion errors, errors in the individual consonants, errors in the triple combinations, and errors that could not be placed in any of the other nine categories, were all considerably more frequent at age 4 than at age 6.

2.6 Comparisons with some results from other Swedish studies

Comparisons with an investigation in Gothenburg (Stenborg & Bengtsson, 1970) of some 700 "normal" 4-year-olds and one in Stockholm (Westerlund, 1963) of "100 six-year-olds with retarded speech development" showed, despite several disparities in method and in the definition of articulation errors, that the ranking of the various consonants as to the number of articulation errors was very similar in the three investigations.

These results give further confirmation that children's articulation of consonant combinations is mainly controlled by the course of the phonematic development, which means according to Jakobson (1952, 1968) that phonemes in all children develop irrespective of their mother tongue in a certain definite hierarchic order. Unfamiliarity with hearing and using certain consonant combinations, however, can also give rise to articulation errors, but in such cases these are not usually of phonematic origin.

The fact that the articulation of consonant combinations very largely depends on children's phonematic development level suggest that a test on consonant combinations is serviceable for identifying children with language problems.

3 STUDIES OF VOCABULARY

For the studies of the children's vocabulary the following five tests were used:

1. Articulation Test
2. Instruction Test
3. Ljungblad's Vocabulary Test
4. Question Test
5. WISC Vocabulary Test

The Instruction Test and Ljungblad's Test measure linguistic perception while the others usually require both perception and production. The Articulation Test and the Question Test were used at both age 4 and age 6, the Instruction Test only at age 4, Ljungblad's and the WISC Vocabulary Tests only at age 6.

3.1 Description of the Articulation Test vocabulary variables

We used as mentioned above, sentence completions, toys and photographic slides to make the children say test words. It sometimes happened that the children did not reply with the predicted test word, sometimes no answer was received at all, and sometimes another word came instead. This produced three measurement variables:

1. Number of predicted word choices - the number of cases in which the children spontaneously replied with the predicted test word.
2. Number of zero answers - the number of cases in which the children gave no answer at all.
3. Number of alternative answers - the number of cases in which the children replied with some other word than that predicted.

The possible reasons for the children not replying with the predicted test word were: a. both the word and the concept it represented were unfamiliar; b. the concept was familiar but the children used another word for it; and c. the stimulus (picture or completion sentence) was unclear.

3.2 Results for the Articulation Test vocabulary variables

The Articulation Tests vocabulary variables showed the following results on investigation of the age differences:

Box 7. Results for the Articulation Test vocabulary variables

Variables	Mean values		Investigation of age difference	
	Age 4 n=240	Age 6	p	ω^2
Predicted word choices	48.50	55.12	xxx	0.41
Zero answers	4.57	0.47	xxx	0.28
Alternative answers	3.66	1.42	xxx	0.25

It will be seen that all the age differences are highly significant. At age 6, the children gave the predicted word choice for 55 out of 57 test words as compared with 49 at age 4.

The investigation of sex differences showed that boys and girls were very similar in the variables of predicted word choices and zero answers, while the boys had a significantly larger number of alternative answers than the girls at age 6 (1.62 compared with 1.20). ω^2 , however, only showed the value of 0.03 for this variable, so that the difference must be considered unimportant.

Studies of the children's answers on the individual test words showed great variation in the frequency of solution. At age 4 all the children gave the predicted word choice for KLOCKA/clock, and 98-99% for SKOR/shoes, STOL/chair, VAGN/carriage, BLOMMA/flower, FISK/fish, BORD/table, SKED/spoon, DRICKER/drinks, HÄST/horse and STRUMPOR/stockings. Only 13%, on the other hand, gave the predicted word choice for DISKBÄNK/sink, 25% for BLIXT/lightning, 32% for TOFS/tassel, 47% for SLIPS/tie and 48% for MOLN/cloud. At age 6, all the children gave the predicted word choice for 14 of the 57 test words. The ranking of the words as to frequency of predicted word choices was about the same for both ages, this being shown by Spearman's rank correlation giving the value of 0.77. All the test words, however, had a considerably greater number of predicted word choices when the children were older: at age 6, 34% of the children gave the predicted word choice for DISKBÄNK/sink, 63% for BLIXT/lightning, 82% for TOFS/tassel, 92% for MOLN/cloud and 93% for SLIPS/tie.

Calculation of the correlations between lexical frequency of predicted word choice for each word and the language frequency of the words according to both Hassler-Göransson (1966) and Allén (1972) showed Spearman's rank correlations of 0.37 and 0.43 at age 4 and of 0.45 and 0.49 at age 6. This indicated that the children more often gave the predicted word choice for the more common words than for the less common ones. Since previous studies have shown that children make articulation errors just as often in familiar words as in unfamiliar, in common ones as in uncommon, it appears that the children's alternative answers and zero answers are rather due to the children not know-

ing the word or concept which the stimulus picture is intended to represent than to their avoiding certain test words because they are hard to articulate.

3.3 Description of the Instruction Test

The test required a doll's house with furniture, fittings and equipment. The children are to furnish the doll's house according to 12 verbal instructions of gradually increasing length given by the tester (Box 8). The children do not need to make any utterances, only to show by their actions that they have understood the instructions.

The following variables were designed:

- 4.¹ Number of correctly carried out instructions. Each task correctly carried out gave one point, the maximum number of points thus being 12.
5. Number of correctly remembered information units. Each word except those in Box 8 within brackets was counted as one information or memory unit. Each correctly remembered information unit gave 1 point, the maximum number of points here being 63. Non-remembered information units were either substituted or omitted, which gave the following variables:
6. Number of omitted information units and
7. Number of substituted information units

3.4 Results for the Instruction Test

The results have been calculated for only 202 of the 252 4-year-olds since the test had to be redesigned after 50 children had been tested with a version that did not function satisfactorily.

The mean value of correctly carried out instructions was 6.85 of 12 possible and the mean value of correctly remembered information units was 52.62 of 63. The number of omitted information units was 5.87 on average and the number of substituted ones 4.32. Comparisons of boys and girls showed no sex differences. The result for each instruction is shown in Box 8.

The result shows that the number of information units is not the only factor determining whether the child will be able to carry out the task, even if all the words are familiar. Comparisons between items E, F and G, which all have 5 information units, and H, I and J, which all have 6, show that instructions containing the combination adjective + substantive (E, H) are easier than those where one adjective is substituted by a preposition (F, I), these in their turn being easier than several substantives together (G, J). The first four instructions point in the same direction. The number of instructions here, however, is far too small to allow of any general conclu-

¹ All the vocabulary variables are numbered consecutively.

Box 8. Results for the Instruction Test

Instruction	Percent correct	
A. GIVE ME (THE) BASKET	3	98
B. PUT-IN (THE) STOVE (AND THE) SINK	3	63
C. PUT (THE) FRIDGE BY (THE) STOVE	4	83
D. GIVE ME (THE) BIG TABLE	4	99
E. GIVE ME TWO LITTLE CHAIRS	5	71
F. PUT (THE) BIG MAT UNDER (THE) TABLE	5	58
G. GIVE ME (THE) SOFA, (THE) TELEPHONE (AND THE) MUMMY	5	44
H. GIVE ME (THE) RED LAMP (AND THE) BIG BED	6	82
I. PUT (THE) LITTLE SAUCEPAN (AND THE) FRYING-PAN ON (THE) STOVE	6	27
J. GIVE ME (THE) DADDY, (THE) TV, (THE) COFFEE-POT (AND THE) DOG	6	21
K. GIVE ME TWO BIG CHAIRS (AND THE) LITTLE TABLE	7	33
L. PUT TWO COFFEE-CUPS, TWO SAUCERS (AND) A SAUCEPAN IN (THE) SINK	9	6
No. of information units:	63	

sions as to how the sentence structure in the instruction affects the ability to remember it.

Analysis of the errors showed that most of the children understood the prepositions 'in', 'by' and 'on', while 'under' was more difficult. Many of the children found difficulty in remembering the concepts 'big' and 'little'.

3.5 Description of the Ljungblad's Vocabulary Test

The Vocabulary Test is part of Ljungblad's Autumn Test for assessing maturational readiness for school, the intention being to give a conception of the children's vocabulary. The children have to find, among a number of given pictures, the one corresponding to a concept given by the tester, eg 'the road that's twisty', 'the fox', 'the house that's smallest', 'the jewel'. As in the Instruction Test, the children do not have to make any utterances, only to show by their actions that they have understood the task. The test contains 24 tasks - 18 single words ('fox', 'tyre', 'jewel' etc) and 6 short sentences (eg 'the house that's smallest').

Since, however, sentences are part of the test, it is doubtful whether one can call this a pure vocabulary test, since it may be supposed that both sentence structure and sentence length affect the ability to carry out the task correctly. Therefore, as well as computing the number of correctly answered tasks in accordance with the manual, I also had the number of correct answers to the 18 single words computed, and the number of correct answers to the six sentences, which gave the following three variables:

8. Number of Ljungblad tasks (max 24)
9. Number of Ljungblad words (max 18)
10. Number of Ljungblad sentences (max 6)

3.6 Results for Ljungblad's Vocabulary Test

At age 6, the children managed 14.39 of the 24 items. The mean value for the 18 words was 10.16 and for the six sentences 4.20. Comparisons of boys and girls showed almost identical results in all three variables. The percentage of correct answers for each individual instruction is shown below.

Box 9. Results for Ljungblad's Vocabulary Test

7. The house that's smallest	100%	16. Cherries	54%
2. Tyre	99%	17. Coins	54%
4. The square that's chequered	93%	3. The road that's twisty	53%
9. Leaf	93%	18. Cogwheel	52%
8. Envelope	89%	15. Jug	51%
1. Fox	88%	22. The thing that's oval	44%
6. Jewel	74%	12. Perch /fish/	44%
5. Case /for jewels/	74%	24. Streamer	34%
13. The animal that's wild	71%	23. Sabre	33%
14. Insects	69%	19. Rowing-boat	28%
11. The picture where you can see an animal crawling	66%	21. Bottle	24%
10. Barn	54%	20. Watch	15%

To judge by the mean values and the above table, there were no signs that the short sentences in the test are more difficult than the single words.

3.7 Description of the Question Test vocabulary variables

The test consist of 10 questions, which were asked in connection with certain pictures in the Articulation Test. In this way the test was made less like an examination and grew more varied and less tiring for the children. None of the questions could be answered by Yes or No. The questions are shown below.

Box 10. Question Test

1. Why do you think I've got a plaster on my hand?
2. What happens if you throw a plate on the floor?
3. What would you do if the curtain caught fire?
4. Why are snakes so dangerous?
5. What games do you usually play when it's snowy?
6. What happens if you forget to turn off the tap?
7. What would you do if you found a purse full of money in the street?
8. What happens to your teeth if you don't brush them?
9. What would you do if you got an elephant as a birthday present?
10. Why do you think boys fight?

The question was repeated once if the child did not answer or answered "don't know". The children's utterances were first assessed according to the frequency of answers, which gave the following three variables:

11. Number of answered questions
12. Number of unanswered questions
13. Number of don't-know answers

Other variables (14-44) have to do with the word frequency; for this, both the number of current words and the number of different words ie lexicon words was computed. Computation of lexicon words was done on a graph level. All identical symbol sequences, ie homographs, were counted as the same graph. The current words were further subdivided into word classes, which were computed both absolutely and percentually.

For calculating the relationship between current words and lexicon words, which is considered to give a measure of the diversity or richness of the vocabulary in one section of speech, Carroll's ratio (1967) was used (lexicon words/ $\sqrt{2 \times \text{current words}}$).

Apart from the above variables, which mainly measure the productive side of the language, some variables concerning language comprehension were also designed. For assessing the children's comprehension of the fact that they had been asked a question requiring some sort of answer, the following calculations were made:

Question comprehension according to the formula (number of answered questions + don't-know answers)/10.

Assessment of the children's understanding of the content of the question was calculated in two ways:

Percentage of relevant SMS (sentence macrosyntagms¹) as the number of relevant SMS/total number of SMS in answered questions.

The following further calculation was made:

Percentage of relevant answers as the number of relevantly answered questions/10. In this case a question has been assessed as relevantly answered if any sentence macrosyntagm in it was relevant. All the variables of the Question Test are given in Box 11.

3.8 Results for the Question Test vocabulary variables

From Box 11 it will be seen that 29 of the 37 variables concerning vocabulary in the Question Test show significant age difference of at least 0.05. The ω^2 value of 20 of these is 0.05 or higher, which has been set as other conditions for differences of importance.

As for the answer frequency, we can ascertain that at age 6 the children answered significantly more questions, and they had fewer don't-know answers and fewer unanswered questions.

For word frequency we can establish that the children at age 6 have significantly more words in all word classes except adverbs, numerals and interjections. Substantives, adjectives and prepositions, however, have an ω^2

¹ Defined in the next chapter.

value below 0.05, which means that the age difference is not so great in these word classes.

To examine whether the distribution of the word classes has changed it is better, however, to make comparisons between the percent variables, because these do not depend on the number of words. One then finds that the proportion of adverbs and substantives has significantly decreased, while the proportions of pronouns, prepositions and conjunctions has significantly increased from age 4 to age 6. Only the adverbs and conjunctions, however, have an ω^2 value above 0.05 (0.06 and 0.10 respectively). The increased proportion of conjunctions at age 6 indicates that when the children are older they begin increasingly to coordinate and subordinate clauses.

The number of current words and lexicon words is significantly higher at age 6 than at age 4, probably partly because the children answered more questions at age 6. Carroll's ratio is therefore a more reliable measure of word variation since it is not dependent on the number of words. This measure shows that at age 6 the children have a significantly richer vocabulary than at age 4.

The don't-know answers at age 6 consistently show low values since they are so few compared with at age 4. The distribution of the word classes here is about the same at the two ages.

All three variables concerning comprehension show significant age differences to the advantage of the 6-year-olds. The difference is less, however, in the variable 'Percentage of relevant SMS', where the relevance has only been assessed in answered questions. The low value in the variable of 'Percentage of relevant answers' at age 4 is largely due to the children having so many unanswered questions and don't-know answers at this age. The variable 'Percentage of relevant SMS' should therefore be a more correct measure for assessing the children's understanding of the content of the questions.

None of the sex differences gave an ω^2 value above 0.02, so that they must be considered as almost without importance.

Analysis of the contents of the various answers showed that at age 4 the children gave vaguer, more general answers while at age 6 they gave clearer and more specifically expressed answers. The contents of the answers at age 6 indicate not only increased knowledge but also increased capacity for logical thought and action and greater creativity in thinking.

Box 11. Results for Question Test vocabulary variables

Variables	Mean values		Investigation of	
	Age 4	Age 6	age difference	ω^2
	n=235		p	
Answer frequency:				
11. Number of answered questions	8.46	9.74	xxx	<u>0.16</u>
12. " " unanswered questions	0.68	0.11	xxx	<u>0.07</u>
13. " " don't-know answers	0.86	0.14	xxx	<u>0.11</u>
Word frequency in answered questions:				
14. Number of substantives	5.60	6.81	xxx	0.03
15. " " verbs	12.09	15.57	xxx	<u>0.08</u>
16. " " adjectives	1.17	1.50	xxx	<u>0.02</u>
17. " " pronouns	8.86	11.50	xxx	<u>0.05</u>
18. " " prepositions	2.47	3.33	xxx	<u>0.04</u>
19. " " conjunctions	2.42	4.43	xxx	<u>0.08</u>
20. " " adverbs	6.40	6.79	n.s	<u>0.00</u>
21. " " numerals	0.06	0.05	n.s	0.03
22. " " interjections	0.01	0.02	n.s	0.02
23. " " current words	39.75	50.76	xxx	<u>0.06</u>
24. " " lexicon words	31.25	39.11	xxx	<u>0.08</u>
25. Carroll's ratio	3.46	3.88	xxx	<u>0.10</u>
26. Percent substantives	15.17	13.65	xx	0.02
27. " verbs	31.69	31.58	n.s	0.00
28. " adjectives	3.11	3.06	n.s	0.00
29. " pronouns	21.31	22.56	xx	0.01
30. " prepositions	6.06	6.73	x	0.01
31. " conjunctions	5.01	7.79	xxx	<u>0.10</u>
32. " adverbs	15.97	13.14	xxx	<u>0.06</u>
33. " numerals	0.14	0.06	n.s	<u>0.01</u>
34. " interjections	0.01	0.04	n.s	0.00
Word frequency in don't-know answers:				
35. Number of verbs	0.87	0.14	xxx	<u>0.11</u>
36. " " pronouns	0.65	0.08	xxx	<u>0.07</u>
37. " " adverbs	0.88	0.14	xxx	<u>0.11</u>
38. " " current words	2.40	0.36	xxx	<u>0.11</u>
39. " " lexicon words	0.87	0.17	xxx	<u>0.12</u>
Word frequency in answered questions and don't-know answers:				
40. Total number of verbs	12.96	15.71	xxx	0.05
41. " " " pronouns	9.51	11.57	xxx	0.03
42. " " " adverbs	7.28	6.93	n.s	0.00
43. " " " current words	42.14	51.12	xxx	0.04
44. " " " lexicon words	32.15	39.29	xxx	<u>0.07</u>
Comprehension:				
45. Percent question comprehension	92.80	98.82	xxx	0.07
46. " relevant SMS	90.33	95.85	xxx	0.04
47. " relevant answers	78.21	92.67	xxx	<u>0.15</u>

3.9 Description of the WISC Test vocabulary variables

The Vocabulary Test is one of the six partial tests included in the verbal part of the general intelligence test known as the Wechsler Intelligence Scale for Children (WISC) for ages 6-15. The test was given only at age 6.

The test contains 40 words for definition. The tester asks the children, "What is a --- (CAR)?" or, "What does a --- (CAR) mean?". The children's answers were scored according to the norms of the manual, the first four words being given 0 or 2 points and the subsequent words 0, 1 or 2 points.

The children's answers were recorded in their entirety since I also wished to assess them in a way analogous to that used for the children's answers in the Question Test, concerning both vocabulary and sentence structure. This not only gave me further knowledge of the children's language, but in addition comparisons between the children's answers in the Question Test and those in the WISC Test gave some information on the importance of stimulus for both quantitative and qualitative aspects of the language, for example whether the children's utterances were of the same length and whether the distribution of the word classes was the same in the two tests. Information of this type is important for such questions as the extent to which generalizations can be made from the interpretation.

So that the children's answers in the WISC Test and the Question Test should be comparable, only the answers to the first 10 words were analysed. Most of the children had attempted to define these, but very few could even attempt to define more. The first 10 words of the WISC Test are:

BIL/car, KNIV/knife, HATT/hat, PARAPLY/umbrella, PORT/doorway, VINTER/ winter, BREV/letter, JÄMNÄRIG/of the same age, GRANNE/neighbour, SPIK/nail
--

All the variables are given in Box 12, together with the results.

3.10 Results for the WISC Test vocabulary variables

Box 12 below gives the results at age 6.

Most of the children gained 2 points for the definitions of the first four words and 1 point for the six following words. Only a few individuals gained any points for any words after the first 10. The mean value was 14.03.

Comparisons of the children's answers in the Question Test (Box 11) with their answers here show that the mean value for answered questions was somewhat higher in the Question Test. Despite this, the mean value for current words is very similar in the two tests (50.76 and 51.11). The word variation, on the other hand, is lower in the WISC Test, as appears from the variables of lexicon words and Carroll's ratio. In the word-class distribution there are also certain differences. The proportions of pronouns and prepositions are higher in the WISC Test, while the proportions of other word classes, especially adverbs, are higher in the Question Test. These differences are probably a function of the question formulation. Several questions in the

Box 12. Results for WISC Test vocabulary variables

Mean value		Mean value	
Age 6		Age 6	
Variables	n=235	Variables	n=235
48. Total WISC points	14.03	67. Percent pronouns	34.98
<u>Answer frequency:</u>		68. " prepositions	10.93
49. Number of answered questions	9.11	69. " conjunctions	7.13
50. Number of unanswered questions	0.31	70. " adverbs	4.75
51. Number of don't-know answers	0.58	71. " numerals	0.17
<u>Word frequency in answered questions:</u>		72. " interjections	0.02
52. Number of substantives	5.23	<u>Word frequency in don't-know answers:</u>	
53. " " verbs	13.66	73. Number of verbs	0.56
54. " " adjectives	0.98	74. " " pronouns	0.50
55. " " pronouns	18.01	75. " " prepositions	0.01
56. " " prepositions	5.39	76. " " adverbs	0.64
57. " " conjunctions	3.91	77. " " current words	1.71
58. " " adverbs	2.69	78. " " lexicon words	1.22
59. " " numerals	0.12	<u>Word frequency in answered questions + don't-know answers:</u>	
60. " " interjections	0.01	79. Total number of verbs	14.21
61. " " current words	51.11	80. Total number of pro-nouns	18.51
62. " " lexicon words	30.15	81. Total number of prep-ositions	5.31
63. Carroll's ratio	2.99	82. Total number of adverbs	3.33
64. Percent substantives	10.96	83. Total number of current words	52.98
65. " verbs	27.01	84. Total number of lexicon words	31.37
66. " adjectives	1.65		

Question Test easily lead to answers beginning with an adverb, while the questions in the WISC Test often begin with a pronoun, for instance "That you can drive with" (CAR), "That you have on your head when it's raining" (UMBRELLA). Comparisons of the children's answers in the two tests thus showed that the stimulus has affected the language in the distribution of word classes and sentence components.

The investigation of sex differences showed no ω^2 value greater than 0.04, so that the differences between boys and girls in this test can be considered as fairly unimportant.

4 STUDIES OF SENTENCE STRUCTURE

The children's sentence structure was studied as follows:

1. In the answers to the 10 questions in the Question Test (cf Box 10).
2. In the answers (definitions) for the first 10 words in WISC Vocabulary Test (cf 3.9).

4.1 Description of the Question Test sentence structure variables

The method used for sentence structure analysis is based on Loman and Jörgensen's technique (1971), but this has been simplified and altered to suit my material.

The children's utterances in answered questions (vocabulary variable 11 in Box 11) were divided into segments comprising a syntactic whole called a macrosyntagm. Loman and Jörgensen make the following remarks about this, *inter alia*:

"It must, moreover, be pointed out that macrosyntagm is here used of phenomena of language use, of the exercise of language - not of the language structure or language system itself. Macrosyntagm is thus used of the word sequences that can be delimited in a longer utterance and which each comprise a syntactically cohesive part of maximum extent, ie that are held together by a system of syntactic relationships - superordination, coordination, subordination. The macrosyntagms may vary very widely in length - from a single-syllable interjection to, for example, a sentence of many words that is expanded with a large number of subordinate clauses." (Loman & Jörgensen, 1971, p 10, our translation)

Box 13 shows how the macrosyntagms have been further subdivided and gives examples of the classifications mentioned. The figures designate the variable numbers (cf Box 14). Missing variable numbers, eg 19, are total or percent variables. The words within brackets in Box 13 are those assumed to be omitted. For a more detailed account of the analysis the reader is referred to the original report. In what follows I shall only consider a few terms.

Sentence macrosyntagms include sentences and sentence fragments.

By sentence is meant here a syntactic construction consisting of main or subordinate clause containing a finite verb, subject and possibly other sentence components.

By unfinished sentence is meant a correctly started syntactic construction that has not been finished due to some missing part at the end of the sentence that is relevant for the context.

Box 13. Classification of macrosyntagms in the Question Test

1	2	5	7	8	6. UNFINISHED SENTENCES	Then I usually ... Then what happens is ...
					9. MAIN CLAUSES	You've hit yourself. It's only because they bite.
					10. ACCEPTED SUBORDINATE CLAUSES	Because it hurts you. Because they've quarrelled.
					11. NON-ACCEPTED SUBORDINATE CLAUSES	That it catches fire. That it got a hole in it.
					12. 13. ACCEPTABLE OMISSIONS OF SUBJECT AND AUXILIARY VERB	(I would) Ring the fire brigade. (I usually) Make snowmen. (I would) Not be in the kitchen
					14. INACCEPTABLE OMISSIONS OF SUBJECT	(It) May bite. (I) Buy things with it. (It) Breaks.
					15. INACCEPTABLE OMISSIONS OF SUBJECT AND AUXILIARY VERB	(You've) Hit yourself. (I'd) Get toothache.
					16. INACCEPTABLE OMISSIONS OF SUBJECT, AUXILIARY VERB AND OBJECT	(I would) Put (it) in my piggy-bank. (I would) Have given (it) to my mummy.
					17. INACCEPTABLE OMISSIONS OF OBJECT IN THE FUNDAMENTAL FIELD	(That ¹) I usually am. (That ¹) You must.
					18. INACCEPTABLE OMISSIONS OF ADVERBIAL IN THE FUNDAMENTAL FIELD	(Then ²) I take it back. (Then ²) Comes the tooth goblin. (Then ²) I'd give it to the police.
					20. 21. UNFINISHED SENTENCE FRAGMENTS	Snowballs that ...
					22. 23. NOMINAL PHRASES	Toboggan and sledge and skis. Tooth goblin.
					24. PREPOSITIONAL PHRASES	With cars. At a time.
					25. ADJECTIVAL PHRASES	Black. Painful.
					26. NON-FINITE VERBS	Ride. Bite.
					3. INTERJECTION MACROSYNTAGMS	Yes, no, mm, hm.
					4. MACROSYNTAGMS OF ADDRESS	Oh, Mummy ...

¹ Demonstrative pronoun, here requiring inversion in Swedish.

² Here requiring inversion in Swedish.

By complete sentence is meant a sentence that has been completed and does not contain any break in the actual sentence structure, for example in the form of a part of the sentence that has been omitted. A complete sentence

consists of main clause, accepted subordinate clause or non-accepted subordinate clause. In Loman and Jørgensen's manual free standing subordinate clauses are considered as sentence fragments. In this rather special situation, however, it is not appropriate to make such an assessment, since the main clause that is missing in the answer is to be found in the actual question. The answer must therefore be considered as both contextually and grammatically correct and is probably the most natural answer even for an adult.

By accepted subordinate clauses are meant free standing subordinate clauses in which the missing main clause is to be found in the question, ie where there is deletion under identity, for example the answer "Because they may bite" to the question "Why are snakes so dangerous?".

By non-accepted subordinate clauses are meant free standing subordinate clauses where it is not possible to say in the same way that the missing main clause is to be found in the question, for example "That it catches fire" as an answer to the question "What would you do if the curtain caught fire?" (see also the examples in Box 13).

By incomplete sentence is meant a finished sentence (main clause or free standing subordinate clause) that contains one or more faults of actual sentence structure due to initial or medial omission of one or more sentence parts such as subject, object, adverbial or auxiliary verb. By an omitted sentence component in the fundamental field (variables 17 and 18) is meant that the missing sentence component should have been placed in the fundamental field, which in Swedish with inversion of word order means immediately before the finite verb. Here too, however, incomplete sentences with certain omitted sentence parts are considered acceptable because in the answer some words are not repeated that occur in the question, for instance "Throw snowballs" as an answer to the question "What games do you usually play when it's snowy?" If on the other hand the child answers the question "What happens to your teeth if you don't brush them?" by saying "Start hurting", where it can also be assumed that the child has omitted "It would", then this answer is assessed as inacceptable, since the question does not contain these words (not deletion under identity). Acceptable omissions only occur in those cases where "I would" or "I usually" is implied in the answers (questions 3, 5, 7 and 9 - see Box 10).

By sentence fragment is meant a syntactic unit containing no finite verb. It most often consists of only one sentence component, for example a nominal phrase.

Some additional entries were made:

Subsidiary clause was noted if the child had a main clause or a free

standing accepted or non-accepted subordinate clause with one or more further subordinate or subsidiary clause in the answer, for instance "Well, it's only because they bite" (main clause + one subsidiary clause) or "Only because they don't want the things they get" (accepted subordinate clause + subsidiary clause).

Compound macrosyntagm was noted for a construction where two macrosyntagms had been interwoven, eg "That's because you've - what's it called - I don't know - hit yourself" (3 macrosyntagms).

It was also recorded if the children made grammatical errors that are not real sentence structure errors, including morphological faults. The following categories of grammatical error occurred:

Errors of word order, eg "I usually - toboggan go on".

Preposition errors, eg "I'd jump out in the window", "Nasty with each other".

Inflection errors, eg "They're angry childs", "bited".

Omitted finite verb, eg "You (have) to ring a man".

Miscellaneous errors, eg incorrect word choice in "We'll come /run/ out of water".

In order to obtain a measure similar to Hunt's number of words per T (terminable) unit (1970) or to the commonly used measure of sentence length, which have both proved to be good indicators of syntactic maturity, the variable SMS length was designed. The number of sentence macrosyntagms was divided by the number of current words in the children's answered questions (vocabulary variable 23 - see Box 11).

Apart from the above mentioned raw score variables, a number of percent variables was designed. All the variables concerning sentence structure in the Question Test are shown in Box 14, where the results are given.

4.2 Results for the Question Test sentence structure variables

It will be seen from Box 14 that there are significant age differences for 27 of the 59 variables, but there are only 15 ω^2 values of 0.05 or higher.

At age 6 the children have significantly more macrosyntagms, sentence macrosyntagms and interjection macrosyntagms. This may partly be a function of the greater number of questions answered at age 6 (cf Box 11).

It will be seen from the percent variables that the distribution of macrosyntagms shows no significant age differences for the sentence macrosyntagms or the macrosyntagms of address (very few at age 4 and none at all at age 6), but on the other hand the difference is highly significant for the interjection macrosyntagms. The occurrence of such interjections as an intro-

ducing "well", "mm" or "er", which were the most common, indicates a kind of adjustment to the listener. This is a skill of communication technique following along with the social development. Increasing occurrence of these interjections thus shows that the children have a more socially functional language at age 6 than at age 4.

For the sentence macrosyntagms, the proportions of sentences and sentence fragments show significant age differences according to the F ratios, but the ω^2 values are only 0.02 and 0.01. This difference must therefore be considered fairly unimportant, but it suggests that the proportion of sentences increases with age at the expense of the proportion of sentence fragments.

Box 14. Results for Question Test sentence structure variables

		Mean value		Investigation of age difference	
Variables	n	Age 4	Age 6	p	ω^2
Raw score variables:					
1. Number of macrosyntagms:	235	11.00	12.44	xxx	0.05
2. " " sentence macrosyntagms	"	9.48	10.80	xxx	0.05
3. " " interjection macrosyntagms	"	0.52	1.24	xxx	0.06
4. " " macrosyntagms of address	"	0.01	0.00	n.s	0.01
(don't-know answers)	"	(0.96)	(0.36)		
(repetitions)	"	(0.05)	(0.04)		
5. " " sentences, total:	"	8.51	9.91	xxx	0.05
6. " " unfinished	"	0.22	0.16	n.s	0.00
7. " " finished	"	8.29	9.74	xxx	0.06
8. " " complete finished sentences:	"	4.53	5.31	xxx	0.02
9. " " main clauses	"	3.61	3.57	n.s	0.00
10. " " accepted subordinate clauses	"	0.76	1.49	xxx	0.11
11. " " non-accepted subordinate clauses	"	0.17	0.26	n.s	0.01
12. " " incomplete finished sentences:	"	3.76	4.43	xxx	0.03
13. " " acceptable omissions of subject and auxiliary verb	"	1.01	2.27	xxx	0.23
14. " " unacceptable omissions of subject	"	1.60	1.22	xxx	0.03
15. " " unacceptable omissions of subject and auxiliary verb	"	0.31	0.28	n.s	0.00
16. " " unacceptable omissions of subject, auxiliary verb and object	"	0.01	0.05	x	0.02
17. " " unacceptable omissions of object in the fundamental field	"	0.02	0.03	n.s	0.00
18. " " unacceptable omissions of adverbial in the fundamental field	"	0.90	0.66	xx	0.02
19. " " unacceptable omissions, total	"	2.84	2.23	xxx	0.04
20. " " sentence fragments:	"	0.87	0.84	n.s	0.00
21. " " unfinished	"	0.00	0.00	-	-
22. " " finished:	"	0.86	0.84	n.s	0.00
23. " " nominal phrases	"	0.43	0.46	n.s	0.00

Box 14. (cont.)

Variables	n	Mean value		Investigation of age difference ₂	
		Age 4	Age 6	p	ω
24. Number of prepositional phrases	235	0.08	0.08	n.s	0.00
25. " " adjectival phrases	"	0.08	0.09	n.s	0.00
26. " " non-finite verbs	"	0.28	0.20	n.s	0.01
27. " " grammatical errors:	"	0.53	0.47	n.s	0.00
28. " " errors of word order	"	0.14	0.05	xx	0.02
29. " " preposition errors	"	0.08	0.07	n.s	0.00
30. " " inflection errors	"	0.09	0.16	x	0.01
31. " " omitted finite verbs	"	0.05	0.05	n.s	0.00
32. " " miscellaneous errors	"	0.18	0.15	n.s	0.00
33. " " subsidiary clauses	"	0.35	0.63	xxx	0.02
34. " " compound macrosyntagms	"	0.00	0.06	xxx	0.03
Percent variables:					
Of macrosyntagms:					
35. % sentence macrosyntagms	"	85.72	88.04	n.s	0.01
36. " interjection macrosyntagms	"	4.08	8.45	xxx	0.06
37. " macrosyntagms of address (don't-know answers) (repetitions)	"	0.09 (8.72) (0.46)	0.00 (2.91) (0.32)	n.s	0.01
Of sentence macrosyntagms:					
38. % sentences	"	88.57	91.86	xx	0.02
39. " sentence fragments	"	10.54	7.69	xx	0.01
Of sentences:					
40. % unfinished sentences	234	2.29	1.45	n.s	0.01
41. " finished sentences	"	97.72	98.56	n.s	0.01
Of finished sentences:					
42. % complete sentences	"	51.43	52.36	n.s	0.00
43. " incomplete sentences	"	48.65	47.71	n.s	0.00
Of finished complete sentences:					
44. % main clauses	217	79.73	62.59	xxx	0.09
45. " accepted subordinate clauses	"	16.69	32.71	xxx	0.09
46. " non-accepted subordinate clauses	"	3.60	4.74	n.s	0.00
Of finished incomplete sentences:					
47. % acceptable omissions of subject and auxiliary verb	"	26.85	52.74	xxx	0.19
48. " unacceptable omissions, total	"	72.59	47.59	xxx	0.18
Of finished sentence fragments:					
49. % nominal phrases	74	53.70	55.77	n.s	0.00
50. " prepositional phrases	"	5.51	8.32	n.s	0.00
51. " adjectival phrases	"	11.59	12.49	n.s	0.00
52. " non-finite verbs	"	29.16	23.42	n.s	0.00
Of grammatical errors:					
53. % errors of word order	36	24.78	9.03	n.s	0.05
54. " preposition errors	"	11.11	8.33	n.s	0.00
55. " inflection errors	"	9.03	26.86	x	0.07
56. " omitted finite verbs	"	11.11	17.36	n.s	0.01
57. " miscellaneous errors	"	43.97	38.42	n.s	0.00
58. SMS length (no. of current words per sentence macrosyntagm)	235	4.01	4.59	xxx	0.05
59. MS length (no. of current words per macrosyntagm)	"	3.72	4.05	xxx	0.02

Both complete and incomplete sentences are significantly more at age 6 than at age 4, which is probably also a function of the greater number of questions answered by the children at age 6 (ω^2 however less than 0.05). The proportions of complete and incomplete sentences are almost exactly the same at each age.

The ratio of main clauses to subordinate clauses shows an interesting age difference. The complete sentences of the 4-year-olds consist of about 80% main clauses and about 17% accepted subordinate clauses. At age 6 the proportion of main clauses has dropped to about 63% and that of accepted subordinate clauses risen to about 33%. The proportions of non-accepted subordinate clauses are about the same at each age. This increase in the proportion of subordinate clauses at age 6 and the significant increase in subsidiary clauses (Variable 33) corroborates previous results of language researchers including those of Hunt (1970).

The distributions within the incomplete sentences also show interesting and significant age differences. The 4-year-olds have about 27% acceptable omissions of subject and auxiliary verb and about 73% of different types of non-acceptable omissions. By age 6 the proportion of acceptable omissions has increased to about 53% and that of the non-acceptable omissions fallen to about 48%. The differences are highly significant, with ω^2 values of 0.19 and 0.18.

The various types of sentence fragment show no age difference. They are similar in both number and distribution at each age. Nominal phrases and non-finite verbs are most common at both ages.

The grammatical errors are quite uncommon, as is clear from the low mean values. Only 36 of the children have any grammatical error at age 4 or 6, so that one can hardly draw any general conclusions concerning the distribution of the different types of grammatical error.

Compound macrosyntagms do not occur at all at age 4 and are rare at age 6.

Both the macrosyntagms and the sentence macrosyntagms are longer at age 6 than at age 4. The SMS length in particular shows a great age difference.

The results suggest that sentence structure grows increasingly correct with age. The development seems to be moving in the direction of adult language. Certain signs also indicate that the social function of language increases with age.

The investigation of sex differences in sentence structure in the Question Test showed five significant F ratios at age 4. None of the variables, however, had an ω^2 value of 0.05 or higher, so that the effect of sex on these variables must be considered unimportant.

At age 6, 11 of 59 variables showed significant F ratios. One of these was the variable 'Number of sentence fragments', which also had an ω^2 value of 0.06. Many of the other significant variables were related to this variable or had ω^2 values lower than 0.05. The only remaining significant variable with a fairly high ω^2 value, 0.09, and which was not dependent on the sentence fragments was the variable 'Percentage of omitted finite verbs'. There were, however, only 12 children who had this type of grammatical error, so that chance may have played a large part in the sex distribution. Thus one can not draw any general conclusions as to sex difference in this variable.

To sum up one can thus state that the sex differences in the Question Test variables concerning sentence structure are very few and fairly unimportant.

4.3 Description of the WISC Test sentence structure variables

The original intention was to design exactly the same sentence-structure variables as for the Question Test. This did not prove to be possible, however, if there was to be a proper system for the different answer types in the WISC Test. This was because the answers there usually consisted of more or less expanded relative clauses, such as "It's one of those things you drive with", "That you can have on your head" as answers to the questions "What is a CAR?" and "What is a HAT?".

Box 15 shows how the sentence macrosyntagms have been divided into different categories and gives examples. Interjection macrosyntagms and those of address were not recorded, since they occurred so seldom. As in the Question Test, various types of grammatical error were also recorded, but not subsidiary clauses or compound macrosyntagms, which were even more uncommon in these answers. A number of percent variables were also designed. Box 16 shows all the WISC Test variables concerning sentence structure and gives the results.

4.4 Results for the WISC Test sentence structure variables

In the discussion that follows, a number of comparisons are made with the Question Test results for the 6-year-olds in cases where this is possible.

The mean value for the variable sentence macrosyntagms is somewhat lower here than it was in the Question Test: 9.54 compared with 10.72. Seventy percent of the sentence macrosyntagms are sentences and almost 30% sentence fragments. In the Question Test the children had 92% sentences and 8% sentence fragments. The larger proportion of sentence fragments in the WISC Test is probably due to the children often omitting "It is" in their answers to

Box 15. Classification of sentence macrosyntagms in WISC: Vocabulary

SENTENCE MACROSYNTAGMS	FINISHED SENTENCES	MAIN CLAUSES	63. COMPLETE	64. WITH RELATIVE CLAUSE	It's a thing you drive with.	
				65. WITHOUT RELATIVE CLAUSE	You drive with it.	
			66. INCOMPLETE	67. OMITTED SUBJECT	(He) Drives with it.	
				68. OMITTED OBJECT	You drive with (it).	
				69. OMITTED SUBJECT AND OBJECT	(You) Drive with (it)	
				70. OMITTED ADVERBIAL IN THE FUNDAMENTAL FIELD	(Then ¹) You live next door.	
		SUBORDINATES	72. NON-RELATIVE CLAUSES		So you don't get wet.	
			73. RELATIVE CLAUSES	74. WITH 'THAT'	That you drive with.	
				75. WITHOUT 'THAT'	You drive with	
		76. UNFINISHED SENTENCES				When you don't send letters then ...
	SEMI-FINITES	NOUN PHRASES	79. SUBSTANTIVES		Saab. Knife with butter.	
			80. PRONOUN + SUBORD. CLAUSE	81. WITH 'THAT'	Thing that you drive with.	
				82. WITHOUT 'THAT'	Thing you drive with.	
			83. SUBST. + SUBORD. CLAUSE	84. WITH 'THAT'	A car that you drive with.	
				85. WITHOUT 'THAT'	A car you drive with.	
		86. PREPOSITIONAL PHRASES			For driving with.	
		VERB PHRASES	88. FINITE VERBS		Drive. Drive with. Snows and so on.	
			89. INFINITE PHRASES		To drive with.	
			90. ADJECTIVAL PHRASES			Dangerous. Sharp.
			91. COMPARATIVE PHRASES			Like another. Just like a door.
	92. ADVERBIAL PHRASES			Out walking		

¹ Requires inversion of subject and verb in Swedish.

the questions "What is ...?".

The finished sentences consist on average of 45% main clauses and 55% free standing subordinate clauses. In the Question Test the figures were 63% and 37% respectively.

Of the main clauses, 86% are complete and are usually without relative clauses. Incomplete main clauses, ie those containing some kind of sentence

Box 16. Results for WISC Test sentence structure variables

Mean value		Mean value	
Variables	Age 6 n=235	Variables	Age 6 n=235
Raw scale variables, number of:		Percent variables	
60. Sentence macrosyntagms	9.54	Of sentence macrosyntagms:	
61. Sentences, finished:	6.84	100. % finished sentences	70.43
62. Main clauses:	3.23	101. " unfinished sentences	0.26
63. Complete main clauses:	2.79	102. " sentence fragments	29.40
64. With relative clause	0.69	Of finished sentences:	
65. Without relative clause	2.10	103. % main clauses	44.68
66. Incomplete main clauses:	0.44	104. " subordinate clauses	55.60
67. Omitted subject	0.13	Of main clauses:	
68. " object	0.27	105. % complete main clauses	86.19
69. " subject+object	0.03	106. " incomplete main cl.	13.82
70. " adverbial in the fundamental field	0.02	Of complete main clauses:	
71. Subordinate clause:	3.61	107. % main cl. with rel. cl.	19.86
72. Non-relative clauses	0.79	108. " main cl. without rel. clauses	80.15
73. Relative clauses:	2.82	Of incomplete main clauses:	
74. With 'that'	2.06	109. % omitted subject	33.92
75. Without 'that'	0.76	110. " omitted object	54.89
76. Sentences, unfinished	0.03	111. " omitted subject+object	6.82
77. Sentence fragments:	2.67	112. " omitted adverbial in the fundamental field	4.38
78. Nominal phrases:	2.07	Of subordinate clauses:	
79. Substantives	0.64	113. % non-relative clauses	27.92
80. Pronoun+subord. clauses:	1.15	114. " rel. clause with 'that'	51.86
81. With 'that'	0.63	115. " rel. clause without 'that'	20.25
82. Without 'that'	0.52	Of sentence fragments:	
83. Subst.+subord. clause:	0.29	116. % nominal phrases	79.29
84. With 'that'	0.20	117. " prepositional phrases	3.16
85. Without 'that'	0.09	118. " verb phrases	13.37
86. Prepositional phrases	0.11	119. " adjectival phrases	1.34
87. Verb phrases:	0.39	120. " comparative phrases	2.31
88. Finite verbs	0.19	121. " adverbial phrases	0.53
89. Infinite phrases	0.20	Of nominal phrases:	
90. Adjectival phrases	0.04	122. % substantives	35.65
91. Comparative phrases	0.04	123. " pron.+sub. clause with 'that'	28.91
92. Adverbial phrases	0.01	124. % pron.+sub. clause without 'that'	22.65
		125. % subst.+sub. clause with 'that'	9.30
		126. % subst.+sub. clause without 'that'	3.47
		Of verb phrases:	
		127. % finite verbs	54.16
		128. " infinite phrases	45.85

Box 16. (cont.)

Variables	Mean value	Variables	Mean value
	Age 6 n=235		Age 6 n=235
93. Grammatical errors:	0.80	Of grammatical errors:	
94. Errors of word order	0.03	129. % errors of word order	4.57
95. Preposition errors	0.50	130. " preposition errors	61.47
96. Inflection errors	0.00	131. " inflection errors	0.00
97. Omitted verbs	0.03	132. " omitted verbs	2.81
98. Miscellaneous errors	0.25	133. " miscellaneous errors	30.27
99. SMS length	5.26		

structure error in the form of an omitted sentence part, are rather uncommon, as is clear from the low mean value of 0.44.

The subordinate clauses in the WISC Test are hardly comparable to those in the Question Test. The majority of subordinate clauses for the 6-year-olds in the Question Test were assessed as accepted because the omitted main clause was to be found in the actual question. The majority of subordinate clauses in the WISC Test should rather be assessed as non-accepted, since the children usually omit more than those words that are found in the question itself. The statement "So you don't get wet" as an answer to the question "What is an umbrella?" can not be considered as grammatically complete, even if one accepts that the main clause in the question can be omitted. Neither can the answer "That you drive with" be considered as a complete one to the question "What is a car?". Correct answers to these questions would be for example "It's something you need so you don't get wet" and "A car is something you drive with".

The free standing subordinate clauses in the WISC Test should thus rather be considered as incomplete sentences and it seems therefore that, unlike the subordinate clauses in the Question Test, they should not serve as a measure of good language quality but rather the reverse. This assumption is later confirmed in the validation with the aid of the reading and writing tests.

As has already been mentioned, the proportion of sentence fragments is considerably greater than in the Question Test, with a mean value of 2.67 as compared with 0.84. Almost 80% of the sentence fragments in the WISC Test are nominal phrases and 13% verb phrases. In the Question Test as well, the nominal phrases were most common - 56% - followed by 23% non-finite verbs, 12% adjectival phrases and 8% prepositional phrases (Box 14).

The nominal phrases in the Question Test usually consisted of a single sentence component. The classification of the WISC Test nominal phrases (Box 15), however, shows evidence of a considerably larger number of expanded phrases. The result in Box 16 also shows that almost 65% of the nominal phrases consist of substantives or pronoun + subordinate clause (Variables

122-126). This means that the majority of sentence fragments in the WISC Test consist of correct and well expanded structures. Thus it is not appropriate to compare the sentence fragments of the two tests either. The majority of sentence fragments in the Question Test indicated less well developed language, while the majority in the WISC Test indicate well developed language. These assumptions are also confirmed by the validation of the language variables.

Grammatical errors were somewhat more common here than in the Question Test, 0.80 as compared with 0.47. Preposition errors were the most common.

The children's sentences are somewhat longer in the WISC Test, as appears from the SMS length, which was 5.26 here as compared with 4.59 in the Question Test.

The investigation of sex differences shows significant F ratios for only 6 of the 74 variables concerning sentence structure. All the ω^2 values are below the 0.05 limit, so that it can be stated generally that the sex differences in the WISC Test variables concerning sentence structure are both few and unimportant.

To sum up, it can be established that the results for the WISC Test variables concerning sentence structure are in many cases very similar to those for the corresponding variables in the Question Test, but the question is whether the dissimilarities are not greater. The very fact that it was not possible to design and compute the variables of the two test in the same way indicates that the stimulus is of importance for the results. The questions in the WISC Test were probably too similar to each other and of too special a nature to allow of any general conclusions as to child language at the age of 6 on that basis. For this purpose the Question Test is doubtless considerably more suitable. It probably stimulates the production of answers more similar to the children's "normal" speech.

I do consider, on the other hand, that this partial test in the WISC can be useful if one wants to gain an impression of a child's linguistic development level concerning both vocabulary and sentence structure. The wide scatter in many of the variables suggests that there are great variations between the children.

5 STUDIES OF INTERRELATIONS BETWEEN LANGUAGE ABILITIES

5.1 Relations between articulation, vocabulary and sentence structure

The primary aim of computing the correlations between the variables included in the study is to investigate whether the variables can be referred to three linguistic dimensions which may be designated articulation, vocabulary and sentence structure, which I have assumed a priori on the basis of the models of language structure of which an account was given in Chapter 1.

For this purpose, the technique of factor analysis (BMDP4M, Dixon, 1973) was considered the most suitable method. For the choice of variables it was important to find an acceptable balance between the necessity of including as many language measures as possible, that of having a more or less even distribution of variables concerning articulation, vocabulary and sentence structure, and the necessity of avoiding ipsative, algebraically deduced and excessively skewed distributed variables. Box 17 shows which variables were selected. It will also be seen here that four factor analyses were carried out - factor analyses 1 and 2 were computed from 33 variables from the Articulation Test and the Question Test for the same 235 children at ages 4 and 6. These analyses could then show whether the factor structure altered with age. Factor analysis 3 was computed from the above 33 variables plus 3 from the Instruction Test for the 191 children who took part in it. Factor analysis 4 was computed from 54 variables: the above 33 from the Articulation and Question Tests, plus 2 from Ljungblad's Vocabulary Test, 18 from the WISC Vocabulary Test and 1 from Raven's Matrices.

Factor analyses 1 and 2 gave respectively nine and ten unrotated factors with eigen-values higher than 1.00, and so this number of factors was rotated. The two largest factors in both analyses are very similar, as can be seen in Box 18, which includes all significant ($p > 0.26$) variables.

Factor I at both age 4 and age 6 represented long answers (SMS length) with many different words (Carroll's ratio) of all word classes. The sentence structure is characterised by complete sentences in the form of main clauses, and at age 4 also by accepted free standing subordinate clauses, sometimes with an appended subsidiary clause. It may probably be assumed that for such answers a necessary precondition is that the questions have been understood and answered in a relevant manner. The vocabulary variable 'Predicted word

choice' also had significant loading at age 4 on this factor. It can be established on the basis of previous results concerning the development of the language measures that the majority of variables with positively significant loading in Factor I showed a significant development with age and must therefore be assumed to represent good language abilities. This is further supported by the fact that all the variables with negative loadings in the factor, for instance all the articulation errors, don't-know answers, sentence structure errors, showed a significantly reduced frequency with age. Factor I is interpreted as a general language factor for both vocabulary and sentence structure.

Factor II at age 4 showed significant loading for all articulation errors and for question comprehension with minus sign. At age 6 all articulation errors except I-errors have significant loadings in the factor; the I-errors have 0.20. Factor II is therefore interpreted as an articulation factor.

Several other factors had a fairly similar structure at both ages. Some factors can generally be described as representing short but relevant answers in the form of complete sentences (free standing subordinate clauses), sentence fragments or incomplete sentences with both acceptable and unacceptable omissions of subject and auxiliary verb. The factors thus contain measures for both well developed and less well developed language abilities, but these two types are clearly in opposition as is shown by their signs for the factor loadings.

Two factors represented on the one hand alternative answers and on the other predicted word choices. These both come from the Articulation Test and together with zero answers are ipsative.

Two factors represented those articulation errors, mainly substitution errors, which did not have their highest loadings in Factor II.

Some factors represented on the one hand free standing subordinate clauses and at age 6 subsidiary clauses and conjunctions as well, and on the other hand inacceptable omissions of subject and grammatical errors.

Two factors had the highest loading for inacceptable omissions of adverbials in the fundamental field.

Factor analysis 3 showed approximately the same structure as factor analysis 1, especially with regard to the two largest factors, which were nearly identical to the largest two in factor analysis 1. The aim of this third factor analysis was to examine where the variables from the Instruction Test should be grouped. The result showed that they were located in the third largest factor together with the two vocabulary variables from the Articulation Test, predicted word choices and alternative answers. No other variables had

Box 17. Variables in factor analyses 1-4

A=articulation; V=vocabulary; S=sentence structure

Factor analyses 1 and 2 (n=235)	Factor analysis 3 (n=191)
<u>Articulation Test:</u> A20. Remaining O ₁ -errors A21. " O ₂ -errors A22. " S ₁ -errors A23. " S ₂ -errors A25. " S ₀ -errors A26. " T-errors A27. " C-errors A28. " I-errors V 1. Predicted word choices V 2. Alternative answers <u>Question Test:</u> V13. Don't-know answers V14. Substantives V15. Verbs V16. Adjectives V17. Pronouns V18. Prepositions V19. Conjunctions V20. Adverbs V25. Carroll's ratio V45. Question comprehension V47. Relevant answers S 6. Unfinished sentences S 9. Main clauses S10. Accepted subordinate clauses S11. Non-accepted subordinate clauses S13. Acceptable omissions of subject and auxiliary verb S14. Inacceptable omissions of subject S15. Inacceptable omissions of subject and auxiliary verb S18. Inacceptable omissions of adverbial in the fundamental field S20. Sentence fragments S27. Grammatical errors S33. Subsidiary clauses S58. SMS length <u>Total: 33 variables</u>	Same 33 variables as in factor analyses 1 and 2, plus: V 4. Correctly carried out instructions V 6. Omitted information units V 7. Substituted information units <u>Total: 36 variables</u> <u>Factor analysis 4 (n=233)</u> Same 33 variables as in factor analyses 1 and 2, plus: <u>Ljungblad's Vocabulary:</u> V 9. Ljungblad words V10. Ljungblad sentences <u>WISC: Vocabulary:</u> V48. WISC points V51. Don't-know answers V52. Substantives V53. Verbs V54. Adjectives V55. Pronouns V56. Prepositions V57. Conjunctions V58. Adverbs V63. Carroll's ratio S64. Complete main clauses with relative clause S65. Complete main clauses without relative clause S66. Incomplete main clauses S72. Subordinate clauses: non-relative clauses S73. Subordinate clauses: relative clauses S77. Sentence fragments S93. Grammatical errors S99. SMS length <u>Raven's Matrices:</u> R 1. Raven points <u>Total: 54 variables</u>

significant loadings in this factor. The Instruction Test therefore seems rather to measure vocabulary.

Factor analysis 4 gave 15 factors. Three of these, I, III and IV, contained roughly the same variables concerning well developed language abilities in vocabulary and sentence structure, namely word classes, Carroll's ratio, SMS length and different types of complete main clauses from both the

Box 18. The two largest factors in factor analyses 1 and 2

Factor I, age 4		Factor I, age 6	
V15. Verbs	0.91	V15. Verbs	0.92
V17. Pronouns	0.89	V17. Pronouns	0.90
S58. SMS length	0.84	V25. Carroll's ratio	0.85
V20. Adverbs	0.83	V20. Adverbs	0.84
V25. Carroll's ratio	0.82	V14. Substantives	0.84
S 9. Main clauses	0.82	S 9. Main clauses	0.83
V14. Substantives	0.78	V19. Conjunctions	0.80
V19. Conjunctions	0.74	S58. SMS length	0.79
V18. Prepositions	0.67	S33. Subsidiary clauses	0.74
S33. Subsidiary clauses	0.59	V18. Prepositions	0.69
V47. Relevant answers	0.48	S 6. Unfinished sentences	0.45
V16. Adjectives	0.44	V16. Adjectives	0.40
S10. Accepted subordinate clauses	0.41		
V45. Question comprehension	0.40		
V 1. Predicted word choices	0.28		
S20. Sentence fragments	-0.30		
V13. Don't-know answers	-0.46		
Variance: 7.67 (23% of total variance)		Variance: 7.44 (23% of total variance)	
Factor II, age 4		Factor II, age 6	
A21. Remaining O ₂ -errors	0.89	A26. Remaining T-errors	0.82
A20. " O ₁ -errors	0.84	A21. " O ₂ -errors	0.81
A27. " C-errors	0.84	A27. " C-errors	0.81
A26. " T-errors	0.82	A20. " O ₁ -errors	0.75
A25. " SO-errors	0.74	A25. " SO-errors	0.71
A28. " I-errors	0.64	A22. " S ₁ -errors	0.63
A22. " S ₁ -errors	0.41	A23. " S ₂ -errors	0.32
A23. " S ₂ -errors	0.28		
V45. Question comprehension	-0.33		
Variance: 4.44 (13% of total variance)		Variance: 3.70 (11% of total variance)	

Question Test and the WISC Test. In Factor I, which accounted for 16% of the total variance, all the variables of the Question Test had higher loadings than the corresponding variables from the WISC Test, while the reverse was true of the other two factors, which accounted for 6% each. It was assumed that the formation of three so similar factors was due to instrument effect. What is more interesting is that the variables have nonetheless been grouped together and that all three factors showed relations between these particular vocabulary and sentence structure variables. This indicates that children who answered with long, correct sentences with a great variety of words in the Question Test did the same in the WISC Test.

Factor II in analysis 4 accounted for 7% of the total variance and was almost completely identical to Factor II in analysis 2, that is to say that only the articulation variables were significant there.

Factor V, which accounted for 5% of the total variance, showed high loadings for predicted word choices and alternative answers from the Articulation Test, the Ljungblad variables and WISC points. What all these have in

common is probably that they measure the passive vocabulary. In predicted word choices, the children are to find the correct word with the aid of a picture, in Ljungblad's Vocabulary they are to find the correct picture with the aid of a word or sentence. The WISC points show how familiar the children are with a certain word. What is thus measured in all cases is the number of words the children know or understand. This does not necessarily mean, however, that they use these words. The answers to the questions in both the Question Test and the WISC Test show, on the other hand, how many words and which words the children use. It therefore seems likely that word classes, current words, lexicon words and Carroll's ratio represent the active vocabulary. Analogously to this one should also consider the sentence structure variables in the Question Test and the WISC Test as measures of active sentence structure. Even in analyses 1 and 2, the Articulation Test vocabulary variables formed their own factor and in analysis 3 they formed the third largest factor together with the variables from the Instruction Test. Not until analysis 4, however, where the Articulation Test vocabulary variables proved to have the highest correlation with Ljungblad's Vocabulary and WISC points, could they with fair certainty be interpreted as measures of passive vocabulary. The correlations of the Instruction Test with predicted word choices and alternative answers in analysis 3 suggest that this test as well mainly measures passive vocabulary. The children do not need to make any utterance there but simply to show by actions that they have understood the instruction.

Another interesting result concerning the passive vocabulary variables was that these correlated more highly than any of the other language variables of the study with Raven's Matrices. This indicates that the passive vocabulary demands higher cognitive functions than the active vocabulary. The former measures what an individual can achieve - in Chomsky's terminology his competence - while the latter measures what he generally does achieve, ie his performance.

The remaining factors in factor analysis 4 were of a more mixed nature. Most of them are bipolar with on the one hand variables concerning well developed language abilities and on the other hand variables concerning less well developed language abilities.

Factor analyses 1, 2 and 3 gave very similar structures. They all had one large, central factor containing variables measuring well developed language abilities in both active vocabulary and sentence structure. In analysis 4 this central factor was subdivided into three factors, and this was assumed to be due to instrument effect. All the analyses also had a clear articulation

factor and a passive vocabulary factor which was not, however, completely clear before analysis 4. Other factors in the analyses were considerably smaller and represented, often bipolarly, different types of less frequent language phenomena concerning both well developed and less well developed abilities in active vocabulary and sentence structure. This splitting up into a large number of smaller variables is probably connected with the fact that the majority of variables in these factors have very low frequencies and therefore are rather unreliable as well. All this means that one should probably only speak of one central factor for active vocabulary and sentence structure.

Thus the language measures of the present investigation can be said to be structured primarily in three factors: one for active vocabulary and sentence structure, one for articulation and one for passive vocabulary.

Before discussing this linguistic structure I will first give an account of the language variable correlations with reading and writing performances at age 8, since these correlations are of some significance for my model of language structure.

5.2 Articulation, vocabulary and sentence structure at ages 4 and 6 in relation to reading and writing abilities at age 8

All the children in the age 8 examination were tested with Malmquist's reading comprehension test (Malmquist, 1970), which measures children's ability to recognize and read single words. The test consists of 48 squares containing a picture and six words with certain graphical similarities. The children's task is to ring the word that fits the picture. Each correct item earns one point, with a maximum of 48.

For all children in this study attending schools in the municipality of Malmö - about 190 - there was also the possibility of obtaining results from two other tests, Lindhahl's reading-aloud test and a DLS dictation test. The former consists of a list of 153 words increasing in length from two letters to seven. The pupil's task is to read the words as fast and as well as possible, after which the number of correctly and incorrectly read words is counted. The dictation test measures the children's ability to spell 28 words written down on dictation, after which the number of correctly spelt words is counted. Thus for further investigations the following criterion variables were employed:

1. Number of correctly read words from Malmquist's reading comprehension test.
2. Number of correctly read words from Lindahl's reading-aloud test.

3. Number of incorrectly read words from Lindahl's reading-aloud test.
4. Number of correctly spelt words from the DLS dictation test.

First the correlations were computed between these four criteria and all the language variables occurring in the study. Box 19 shows some of the language measures showing the highest correlation ($p < 0.001$) with the criterion concerned. Only one of several variables with high mutual correlation, for example ipsative and algebraically deduced variables, has been included.

The correlations in Box 19 are not particularly high but it is interesting to note that all the criteria apart from 'Lindahl: incorrect' show highest correlation with passive vocabulary variables. 'Lindahl: incorrect' has its highest correlation, however, with certain types of articulation error. The dictation test also shows relatively high correlation with the articulation variables - higher than those of the two reading tests. Of the active vocabulary variables, adjectives, pronouns and prepositions have the highest correlation with the criteria. With the sentence structure variables it is usually the proportion of sentences of the sentence macrosyntagms in the Question Test that has the highest correlation with the reading and writing tests.

Box 19. Variables with the highest significant correlations ($p < 0.001$) with the criteria

Q=Question Test; I=Instruction Test; L=Ljungblad's Vocabulary;

A=Articulation Test; W=WISC: Vocabulary; R=Raven's Matrices

Variables at age 4				Variables at age 6			
Malmquist's reading comprehension test: correctly read words							
V 1. Predicted word choices	(A)	0.47		V 8. Ljungblad tasks	(L)	0.49	
V 4. Correctly followed instr.	(I)	0.28		V48. WISC points	(W)	0.42	
A26. Remaining T-errors	(A)	-0.27		V 1. Predicted word choices	(A)	0.39	
V18. Prepos'ns in answered qs.	(Q)	0.26		A54. Adj. in answered qs.	(W)	0.28	
A 8. Total correct	(A)	0.25		V65. % verbs in answ. qs.	(W)	-0.27	
S38. % sentences	(Q)	0.25		V55. Pronouns in answ. qs.	(W)	0.27	
Lindahl's reading-aloud test: correctly read words							
V 1. Predicted word choices	(A)	0.31		V 8. Ljungblad tasks	(L)	0.40	
S38. % sentences	(Q)	0.27		V48. WISC points	(W)	0.34	
S46. " non-acc. sub. clauses	(Q)	0.25		V54. Adj. in answered qs.	(W)	0.31	
A24. Remaining S ₁ S ₂ -errors	(A)	-0.23		V66. % adj. in answered qs.	(W)	0.31	
				V 3. Alternative answers	(A)	-0.28	
				V65. % verbs in answered qs.	(W)	-0.27	
Lindahl's reading-aloud test: incorrectly read words							
A28. Remaining I-errors	(A)	0.2		A23. Remaining S ₂ -errors	(A)	0.36	
V 3. Alternative answers	(A)	0.22		A 9. " errors, total	(A)	0.26	
DLS dictation test: correctly spelt words							
V 1. Predicted word choices	(A)	0.45		V 1. Ljungblad tasks	(L)	0.38	
V 5. Correct info. units	(I)	0.36		V 3. Alternative answers	(A)	-0.37	
S38. % sentences	(Q)	0.35		V48. WISC points	(W)	0.33	
A 8. Total correct	(A)	0.33		S95. Preposition errors	(W)	-0.26	
A26. Remaining T-errors	(A)	-0.33		A24. Remaining S ₁ S ₂ -errors	(A)	-0.26	
A22. " S ₁ -errors	(A)	-0.32		S93. Grammatical errors	(W)	-0.25	
				A28. Remaining I-errors	(A)	-0.25	

Since several language variables together may give higher correlations than one single variable, I also had a number of multiple correlation analyses carried out (SPSS, Nie et al, 1975).

For this I chose to work with the same variables as previously in the factor analyses (Box 17). I also wanted, however, to test the correlations for some of the raw score variables that are not included there. It was a question of certain language measures that were easy to judge and compute and which might perhaps give as much information as more complicated measures. These variables were:

- from age 4: 5 variables 1. no. of spontaneous correct items and 2. predicted word choices from the Articulation Test;
 3. total no. of current words and 4. sentence macrosyntagms from the Question Test;
 5. no. of correctly carried out instructions from the Instruction Test,
- from age 6: 9 variables same variables as above plus:
 6. WISC points, 7. total no. of current words and 8. sentence macrosyntagms from WISC;
 9. Ljungblad tasks and Raven points.

The multiple correlations were computed both after stepwise inclusion of the 10 predictors that together gave the highest correlation with the criterion, and also after the inclusion of all the predictors. This procedure reveals the maximum multiple correlation so that comparisons can be made between the 10 predictors and all the predictors as far as their multiple correlation with the criteria is concerned.

A total of 24 multiple correlation analyses were carried out according to the model shown in Box 20.

Box 20. Multiple correlation analyses

Criterion	Predictors				
	Age 4 and 6	Age 4	Age 6	Age 4	Age 6
Malmquist's Lindahl: correct Lindahl: incorrect DLS dictation test	same 33 variables as in fac- tor analy- ses 1 and 2	same 36 variables as in fac- tor analy- sis 3	same 54 variables as in fac- tor analy- sis 4	5 specially selected variables	9 specially selected variables
Multiple correlation analyses	1-8	9-12	13-16	17-20	21-24

Box 21 shows the results from the age 4 multiple correlations between the criteria and the 33 variables from the Articulation Test and Question Test, and also the age 6 multiple correlations between the criteria and the 54 variables from the Articulation Test, the Question Test, WISC: Vocabulary

Test and Raven's Matrices.

The results of all the multiple correlation analyses may be summarised in the following points:

1. Ten predictors showed almost as high correlations as all the predictors.
2. Comparisons between multiple correlation analyses 1-4 at age 4 and 5-8 at age 6 which were computed for the same children and the same 33 variables showed higher correlations at age 4 than at age 6 with all criteria except 'Lindahl: correct'. The selection of predictors was also different. Comparisons between the 40 predictors of the two ages (10 from each criterion) showed somewhat fewer vocabulary variables but somewhat more numerous articulation and sentence structure variables at age 6 than at age 4. The passive vocabulary measures of predicted word choices and alternative answers, however, were the first selected predictor for all criteria except 'Lindahl: incorrect' at both ages. In the latter criterion an articulation variable was the first predictor at both age 4 and age 6.
3. Multiple correlation analyses 9-12 were performed with the object of examining the value of the Instruction Test as a predictor. Only one of the variables of this test was among the first ten predictors, namely 'substituted information units', which was No. 8 in 'Lindahl: correct' and No. 6 in the DLS dictation test. The contribution of the variable to the multiple correlation was unimportant. Thus the Instruction Test does not seem to add very much new information in the multiple analyses. As individual predictors, however, all the variables in the test had significant correlations with both Malmquist's reading test and the DLS dictation test, but not with Lindahl's test.
4. Comparisons between multiple correlation analyses 5-8 with 33 variables and 13-16 with 54 variables at age 6 showed quite large differences. The multiple correlations were higher throughout in the latter, both after the introduction of ten and of all the predictors. Comparisons between the same analyses with 40 predictors showed a great increase of the vocabulary variables in favour of articulation and sentence structure variables. The new vocabulary variables represent both passive vocabulary - eg Ljungblad words and WISC points - and active vocabulary - eg adjectives, verbs and Carroll's ratio from the WISC test, which occurred as predictors in several criteria. The non-verbal test Raven's Matrices also proved to be of considerable importance as a predictor for reading and writing abilities. This was introduced as the second predictor in both Malmquist's reading comprehension test and in 'Lindahl: correct'

Box 21. Results for multiple correlation analyses 1-4 (age 4, 33 variables) and 13-16 (age 6, 54 variables)

Age 4			Age 6		
Malmquist's reading comprehension test: correctly read words					
Step	Predictor	Multiple R	Step	Predictor	Multiple R
1	V 1. Predicted word choices	(A) 0.45	1	V 9. Ljungblad words (L)	0.46
2	A26. Remaining T-errors	(A) 0.47	2	R 1. Raven points (R)	0.54
3	V18. Prepositions	(Q) 0.49	3	V 1. Predicted wd. choices	(A) 0.57
4	V 3. Alternative answers	(A) 0.49	4	V54. Adjectives	(W) 0.58
5	S 6. Unfinished sentences	(Q) 0.50	5	V53. Verbs	(W) 0.59
6	S18. Inacc. omiss. advbl fund.	(Q) 0.52	6	S14. Inacc. omiss. of subject	(Q) 0.60
7	S11. Non-acc. subord. clauses	(Q) 0.52	7	V48. WISC points	(W) 0.60
8	S20. Sentence fragments	(Q) 0.53	8	V63. Carroll's ratio	(W) 0.61
9	V17. Pronouns	(Q) 0.54	9	S58. SMS length	(Q) 0.61
10	V20. Adverbs	(Q) 0.55	10	V20. Adverbs	(Q) 0.62
33	(n=223)	0.58	54	(n=222)	0.68
Lindhahl's reading-aloud test: correctly read words					
Step	Predictor	Multiple R	Step	Predictor	Multiple R
1	V 1. Predicted word choices	(A) 0.29	1	V 9. Ljungblad words (L)	0.40
2	S20. Sentence fragments	(Q) 0.36	2	R 1. Raven points (R)	0.45
3	S11. Non-acc. subord. clauses	(Q) 0.39	3	V54. Adjectives	(W) 0.48
4	A23. Remaining S ₂ -errors	(A) 0.41	4	A25. Remaining SO-errors	(A) 0.50
5	S18. Inacc. omiss. advbl. fund.	(Q) 0.42	5	V53. Verbs	(W) 0.51
6	V18. Prepositions	(Q) 0.43	6	V55. Pronouns	(W) 0.53
7	S 9. Main clauses	(Q) 0.44	7	V19. Conjunctions	(Q) 0.54
8	V20. Adverbs	(Q) 0.45	8	A20. Remaining O ₁ -errors	(A) 0.56
9	S13. Acc. omiss. subj.+ aux.	(Q) 0.46	9	V 3. Alternative answers	(A) 0.56
10	V45. Question comprehension	(Q) 0.48	10	S13. Acc. omiss. subj.+ aux.	(Q) 0.57
33	(n=172)	0.52	54	(n=171)	0.65
Lindhahl's reading-aloud test: incorrectly read words					
Step	Predictor	Multiple R	Step	Predictor	Multiple R
1	A28. Remaining I-errors	(A) 0.24	1	A23. Remaining S ₂ -errors	(A) 0.36
2	V 3. Alternative answers	(A) 0.32	2	A25. Remaining SO-errors	(A) 0.38
3	V 1. Predicted word choices	(A) 0.35	3	V18. Prepositions	(Q) 0.40
4	S 6. Unfinished sentences	(Q) 0.37	4	S99. SMS length	(W) 0.41
5	A22. Remaining S ₁ -errors	(A) 0.38	5	V19. Conjunctions	(Q) 0.43
6	S15. Inacc. omiss. subj.+ aux.	(Q) 0.39	6	V15. Verbs	(Q) 0.46
7	V16. Adjectives	(Q) 0.40	7	S10. Accepted subord. clauses	(Q) 0.47
8	V17. Pronouns	(Q) 0.41	8	V63. Carroll's ratio	(W) 0.48
9	V18. Prepositions	(Q) 0.43	9	V13. Don't-know answers	(Q) 0.49
10	V15. Verbs	(Q) 0.44	10	V16. Adjectives	(Q) 0.50
33	(n=172)	0.49	54	(n=172)	0.58

Age 4			Age 6		
DLS dictation test: correctly spelt words					
Step	Predictor	Multiple R	Step	Predictors	Multiple R
1	V 1. Predicted word choices	(A) 0.45	1	V 3. Alternative answers(A)	0.37
2	A25. Remaining SO-errors	(A) 0.53	2	A28. Remaining I-errors	(A) 0.45
3	S20. Sentence fragments	(Q) 0.54	3	V 9. Ljungblad words	(L) 0.49
4	A22. Remaining S ₁ -errors	(A) 0.56	4	S93. Grammatical errors	(W) 0.51
5	A27. " C-errors	(A) 0.57	5	S58. SMS length	(Q) 0.53
6	A28. " I-errors	(A) 0.58	6	S18. Inac. omiss. advbl. fund.	(Q) 0.54
7	V45. Question comprehension	(Q) 0.58	7	V16. Adjectives	(Q) 0.56
8	S33. Subsidiary clauses	(Q) 0.58	8	V20. Adverbs	(Q) 0.57
9	V17. Pronouns	(Q) 0.59	9	V54. Adjectives	(W) 0.58
10	S58. SMS length	(Q) 0.59	10	R 1. Raven points	(R) 0.59
33	(n=175)	0.63	54	(n=174)	0.67

after Ljungblad words and as the tenth predictor in the dictation test.

5. Multiple correlation analyses 17-24 showed throughout lower correlations with the criteria than the corresponding number of predictors in other analyses. The highest correlation was shown by 'predicted word choices' and the variables from Ljungblad's Vocabulary Test, WISC: Vocabulary Test and Raven's Matrices, which had of course proved to be valuable as predictors in other analyses. Among the other total variables, only 'spontaneous correct items' may be said to have any major prediction value in these multiple analyses. This variable was the first predictor twice, in the dictation test at age 4 and in 'Lindahl: incorrect' at age 6, and it was the second predictor in the three other criteria at age 4 and in the dictation test at age 6.

5.3 Models for language ability structure

On the basis of the results obtained in the study here presented, chiefly those from the factor analyses and the multiple correlation analyses, I shall now close the circle by referring to, and making comparisons with, some of the models of language or language ability structure mentioned and discussed in Chapter 1, and finally give an account myself of a hypothetical model for language ability.

A comparison between my own results and those of Löfgren (p. 12) regarding the three language factors that could be interpreted with certainty shows considerable similarities although we had examined language ability in different age groups, had used quite dissimilar measuring instruments and also tested abilities in different languages. Each of us found a central factor for both vocabulary and sentence structure, according to Löfgren's terminology a vocabulary and grammar factor. We both also found a clear ar-

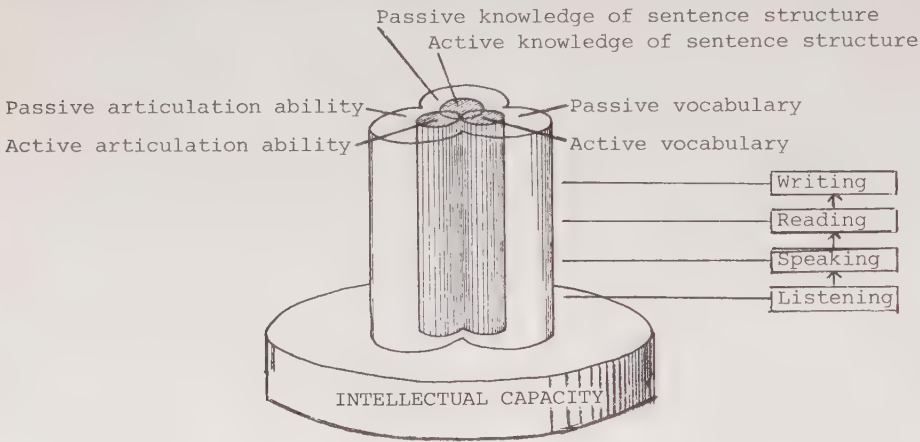
ticulation factor. Löfgren's intelligence factor and my passive vocabulary factor seem to me also to have some similarities. In this respect one should also note that reading comprehension tests have consistently had their highest loadings in Löfgren's intelligence factor. It became apparent that the variables in my passive vocabulary factor were those which had the highest correlation with the children's reading and writing performances, where of course reading comprehension was included. The passive vocabulary variables were also those which had the strongest correlation with Raven's Matrices, ie an intelligence test which, like one of Löfgren's tests, may be said to measure the logical-inductive capacity. One of the passive vocabulary variables, moreover, was the WISC points, which are included in an intelligence test (Wechsler Intelligence Scale) specially intended for measuring verbal intelligence. This indicates that there are correlations between intelligence, reading comprehension and passive vocabulary.

In Sigurd's model (p.11) there are also three factors. It is quite clear that two of the factors that are both my own and Löfgren's can fit into this model well. My factor for active vocabulary and sentence structure and Löfgren's vocabulary and grammar factor would then correspond to Sigurd's morphosyntactical component, which shows "how we clothe our thoughts". Our articulation factors would then of course correspond to Sigurd's phonological component. The semantic component reveals the thoughts, says Sigurd, and is hierarchically superior to the two others. This suggests that the semantic component has a higher cognitive function, or is possibly even identical to "intelligence". It is but a short step from here to find similarities between this latter, Löfgren's intelligence factor and my passive vocabulary factor. Neither Löfgren nor myself, however, have empirically succeeded in showing any hierarchic arrangement of the factors. Theoretically and logically considered, however, this seems perfectly well conceivable, for we speak of both passive and active vocabulary, meaning by this that we can understand considerably more words than we use. Löfgren also speaks of passive and active structure knowledge, and I myself have pointed out in connection with the interpretation of the passive vocabulary factor that the language variables for sentence structure in both the Question Test and the WISC Test should be considered as measures of active sentence structure in the same way as the words in these tests are considered as measures of active vocabulary. Everyone knows that children understand language earlier than they use it and speak it, and here it is of course not only a question of understanding isolated words but also relationships between words, ie sentence structure. Several researchers have shown, moreover, that children understand more than they can give expression to; these researchers include Fraser, and Bellugi

and Brown (1963).

The passive knowledge of vocabulary and sentence structure is thus greater than the active use of them. One should thus be able to say that the former stands in a superior relationship to the latter. In analogy with this one should then also speak of a passive articulation ability standing in a superior relationship to an active one, for it is clear that a child understands the sounds in the words and sentences before mastering them phonematically. The above chain of reasoning leads to my own model for language ability.

Hypothetical model of language ability structure:



As appears from the figure, I conceive language ability as represented by three cylindrical columns, which symbolize the three factors of articulation, vocabulary and sentence structure. The sectional areas intersect to illustrate how they are all interrelated at the same time as being clearly distinct from each other. Within each column there is a thinner column, also placed so that it intersects the two other thin columns. These three thin columns symbolize the active portion of each language factor, ie active articulation ability, active vocabulary and active knowledge of sentence structure. The thick columns represent the passive abilities, ie passive articulation ability, passive vocabulary and passive knowledge of sentence structure. The three columns representing language ability stand on a base, which I have designated intellectual capacity. I am not arguing for or against any special theory of the structure and organization of intelligence; my figure is only intended to emphasize the importance of intellectual capacity for the development of language ability. I am aware that linguists, psychologists, educational theorists and many other researchers have long been discussing the question of whether it is language that controls cognitive development or the

reverse. I myself am inclined to support the view that higher cognitive functions are necessary for normal language development, but that there then occurs an interaction between linguistic and cognitive development. Without any kind of language our learning possibilities will doubtless be extremely limited and hampered.

It seems in any case likely that there is a connection between intellectual capacity and language ability. I am here referring to the correlations obtained in my study between passive vocabulary and Raven's Matrices, and to the correlations obtained by Löfgren between various intelligence tests and reading comprehension - the latter itself being a passive language ability. In my model for the connection between language ability and intellectual capacity, it will be quite easy to understand why both of us obtained higher correlations between passive language abilities and intelligence than between active language abilities and intelligence. This is because the passive abilities are so to speak larger than the active ones, and in my model they cover a larger area of the intellectual capacity, which is bound to result in higher correlations. The height of the columns also, of course, increases the correlations with intellectual capacity, since there is then a greater volume resting upon this base of intellectual capacity. In this way, therefore, passive knowledge of written language should show higher correlations than passive knowledge of spoken language, which of course develops and is mastered at an earlier stage.

Learning language begins with receiving passive knowledge of language sounds, words and sentences. This passive knowledge can be measured by studying the comprehension - that is, the perception - of spoken language. As the passive knowledge of various types increases, so in due course develops the active use of language, for example in the form of speech. These active abilities can be measured by studying the use - that is, the production - of language. According to the intellectual capacity there is then an increase in both the passive and the active knowledge of language sounds, words and sentences. After a certain time each individual masters the phonemes of the native language, which may in the end mean that at more advanced ages it will be hard to separate any special articulation factor. During the learning of foreign languages, however, it still seems to be possible to measure the articulation and obtain a separate articulation factor - something that Löfgren, for example, has shown in his studies of the German language ability of Swedish pupils. It is also conceivable that the articulation factor will, as it were, crop up in the form of what one might call a spelling factor at later ages. This supposition is supported by the fact that the articulation

ability in my 4-year-olds showed many fairly high correlations with the spelling ability of the children at age 8. The studies of the children's language abilities at ages 8 and 10 should be able to give empirical proof of this theory.

My model of language ability shows only how I have conceived of it as being composed of different language factors. The question of how all the external factors in the social, intellectual and cultural environment affect language abilities has not even been touched on. I hope to have the opportunity in due course of making a more detailed study of this, and also of making use of further empirical studies to falsify or verify my hypothetical model of language ability structure.

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